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AMERICAN MACHINIST

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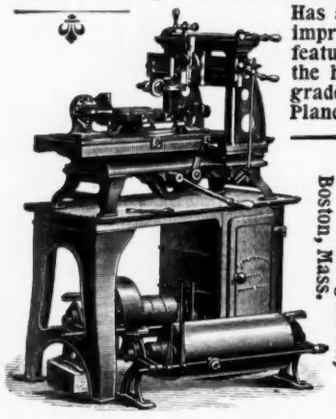

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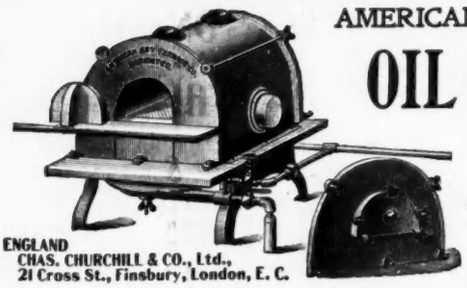

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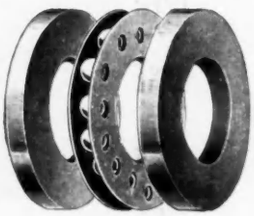

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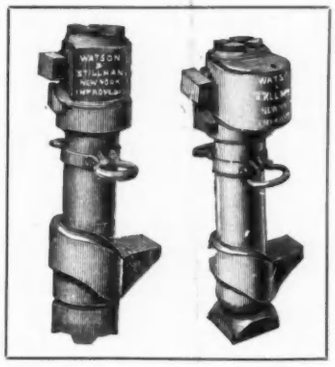

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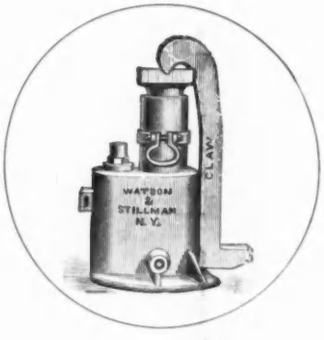

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Cushman Chuck Co., Hartford, Conn.
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Whiton Machine Co., D. E., New London, Conn.

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Hurlbut-Rogers Mach. Co., So Sudbury, Mass.

Dies, Screw Cutting.
Acme Machinery Co., Cleveland, O.
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Dietz, Schumacher & Boye, Cincinnati, O.
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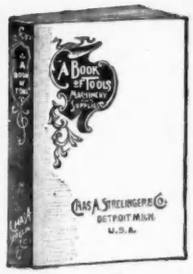

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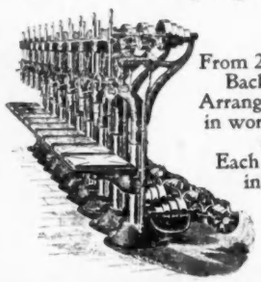

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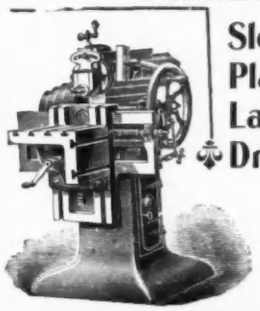
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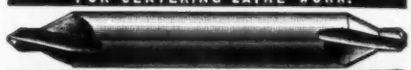
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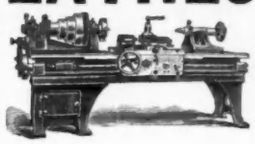
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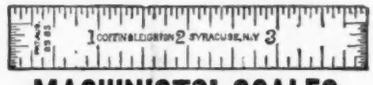

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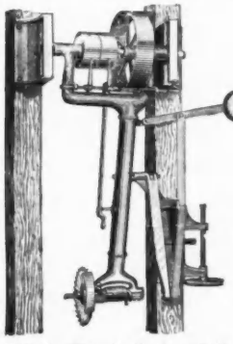

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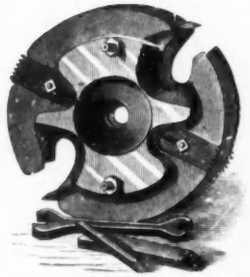

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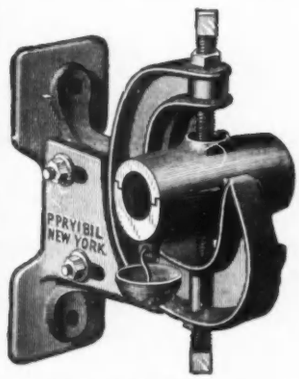

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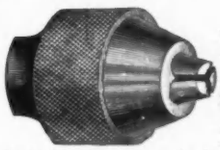

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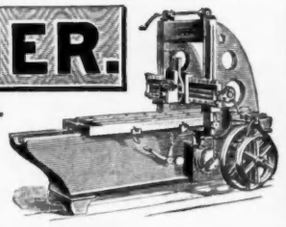

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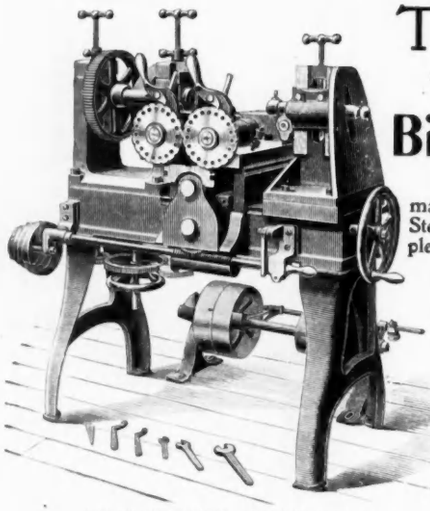

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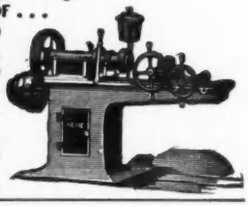

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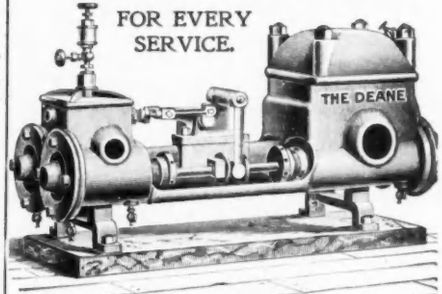

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VOLUME 19. NEW YORK, THURSDAY, SEPTEMBER 24, 1896. NUMBER 39.

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Tool Room Equipped from the Scrap Pile—Substitute for Chalk—Book of Blueprints—Belt Diagram.

Being in St. Louis at the time of the spring meeting of the American Society of Mechanical Engineers, I naturally looked about among the machine shops, a little, and found in one of them my friend, S. E. Freeman, whose acquaintance I had previously made in a Philadelphia shop. Mr. Freeman is now superintendent of the works of Todds & Stanley Mill Furnishing Co., which has long been one of the best-known mill furnishing establishments in the country, and has enjoyed and still enjoys an excellent reputation in its line. The business has made money for its proprietors, as a result of good business and technical management; but the too common mistake made by old-established concerns, of keeping on in the old lines until the money previously made is all lost again, is not being made in this instance. On the contrary, the time came when it was seen plainly enough that new blood, new ideas and a general modernizing of methods were advisable, and steps were taken to rejuvenate things. To help in this work is the present mission of my friend, Freeman, and in carrying it on he is doing a number of things that I found interesting and propose to give some account of:

A TOOL ROOM EQUIPPED FROM SCRAP.

I dare say, Mr. Editor, that you never saw a complete tool-room equipment made from scrap iron of all kinds that had lain in a cellar under a shop for years—an accumulation of things that "may come in handy some time," but that in reality never do. And I imagine I hear you say that you "don't want to see any such an equipment for a tool room, either." But, really, this tool room was worth seeing. The grinder, milling machine, etc., did not look as though they were patched up out of odds and ends, and did not tremble and chatter and threaten to fall to pieces every time the belts began to pull a little, the reason being that the man who worked this transformation scene went about it in the proper way. He simply sold the scrap and invested the money in regular "made a-purpose" tools.

Of course, he had to have a good deal of scrap; but there are lots of o'd-established and successful shops in the country that are without tool rooms, and that have plenty of scrap to make one out of in this way, and my friend simply happened to strike one of them. And when I think of these shops blundering along in the darkness of tool-roomless heathenism, and of the difference in productive value between a well-equipped, well managed tool room and a lot of old miscellaneous scrap, the actual utility va'ue of which is exceeded by the yearly rental value of the space it takes up, I am impressed with the fact that there is a lot of missionary work yet

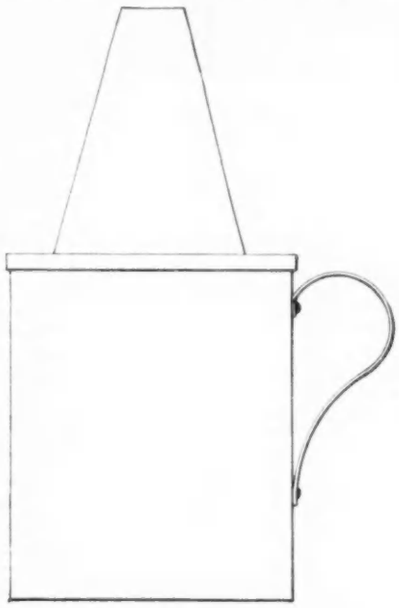


Fig. 1. SUBSTITUTE FOR CHALK.

to be done, and a lot of good jobs at good pay for intelligent young fellows who have never learned how to run shops without tool rooms.

The real problem is to bring these men and these shops together; the rest will follow naturally enough; and in this work of bringing them together the "American Machinist" is probably the most influential factor, as it is also in educating both mechanics and shop proprietors to a realization of the immense advantages of systematic, modern and efficient methods.

Scrap accumulates piece-meal. Each addition to it is thought at the time to have a possible future value. If any such possibility does actually exist at the time, it soon disappears; but the man who formed the pile has in mind the fact that as he formed it he had, or thought he had, some reason for keeping each individual piece of it, and, therefore, there are, stowed away in his head, as many reasons for keeping the whole pile as there are pieces in the pile. A stranger comes along and—knowing nothing of these reasons, but seeing a pile or a cellarful of spoiled castings, partly or wholly worn-out machines or parts of machines, odd pulleys and gears, that perhaps look good enough for service, but which no machinist would actually put into use if he could help it—simply says: "This is scrap; the fact that none of it has been used for many years proves that none of it ever will be used. Away with it!" It goes, and the materials which composed it are made useful, the shop looks better, there is more room in which to turn and plane and drill, and some money with which to buy tools for performing these various operations. I+ is not always so much a matter of superior sight as it is a different standpoint from which to view the matter.

In this instance, curiously enough, the room formerly taken up by this scrap is now occupied by a Corliss engine which drives the shafting, and an electric lighting plant—the former put in on the plan followed by Geo. H. Corliss when he first began to introduce his engine and found difficulty in persuading people of the advantages of an automatic engine, i. e., it was contracted to be paid for in a percentage of fuel-saving, and Mr. Corliss' common experience was repeated and a settlement made before the term during which payments were to have been made had expired.

A SUBSTITUTE FOR CHALK.

Most of us, I trow, know of but two ways of preparing the surface of a casting or forging for "laying out." If it is smooth work, and we want to do a nice job, we copper-plate it with bluestone; and nothing can be better than this. If it is rough, we rub chalk over it; and nothing could be worse.

I saw here a third and, to me, a new way, which, for laying off work having rough surfaces, is infinitely superior to chalk. The special tool required was simply a can like that shown in the sketch Fig. 1, which is a plain cup of tin or galvanized

iron, with a cover having a cone on top of it, the object of which cone is simply to allow the handles of two paint brushes to protrude from the cup proper and yet keep the whole affair tight. The brushes are hung on a wire which crosses the cup inside, small hooks being driven into the brushes for that purpose. The paint used is white lead, mixed with gasoline. It is no sooner brushed onto the work to be laid off than the gasoline evaporates, leaving a coating of white lead, which scribers and dividers cut through and make a distinct, clean, sharp line which is not readily effaced. Covered in this way, the gasoline does not evaporate from the cup too rapidly, and I am convinced that this is an excellent plan.

A LAYER-OUT.

I found this paint can standing on a planed cast-iron table 4 feet long and 2 wide, just outside the door of Mr. Freeman's office, and, noticing there with it other more familiar things, such as a surface gage, parallel strips, wedges, clamps, scribers, etc., (but no chalk) I perceived that it was a "laying-out" table, and upon inquiry found that this work is all done by one man who is used to it, works in a good light and has all the necessary appliances, and is, in short, a specialist. This results in economy of labor and avoids some mistakes; but those who know much about human nature as it is found in machine shops will be apt to think as I did, that a man would sometimes not drill a hole precisely where it was laid off to be drilled and would then claim that the laying-off was wrong. I found that this difficulty had been met with and had been forestalled by laying off as shown at Fig. 2, where the four outer center punch marks are outside the drilling line, but are equidistant from the center, and, after the hole is drilled, they remain as witnesses and show just where the layer-off intended the hole should be drilled. If it is not there he is able to contemplate the spoiled work with considerable equanimity so long as his witness marks are all right.

A BLUEPRINT REFERENCE BOOK.

The regular reference books, tables, etc., are all right in their way; but we all know that, as we go along, we each find some things that must be more fully or at least differently treated to adapt them to our particular needs. Each shop has certain things it uses more than others, and which it pays to get into the most convenient form for reference and constant use. I noticed, lying on Mr. Freeman's desk, his plan for carrying out this idea. It consisted of a number of blueprint sheets 9 x 12 inches (standard), bound together with fasteners such as are sold by stationers, so as to form a book with a paper cover. Each sheet of this book was a blueprint of a diagram, collection of formulæ, table of sizes, or something of that sort, especially adapted to his requirements. Looking them over, I noticed among them sheets giving standard proportions of finished bolts, nuts and washers; pipe dimensions; proportions of steel keys in shafts; formulæ and tables of strength of gear teeth; a table giving pitch diameters of gear wheels for all commonly used circular pitches up to 3 inches and up to 60 teeth; a table and formulæ for proportions of gear teeth; diagrams of strength of shafting; belt diagrams, and many others most used in their line of work. I give herewith a typical sheet, which is for belting, and is so arranged that, having the other factors, any one unknown factor may be readily determined. A little study, and especially a few concrete cases traced out on this diagram, will readily show how it works and also its great convenience.

Suppose, for instance, we have a 40-inch pulley to run 200 revolutions per minute, and wish to take from this pulley 10 horse-power: What we wish to know is—how wide must the belt be?

At the extreme top of the diagram is a row of figures standing for pulley diam-

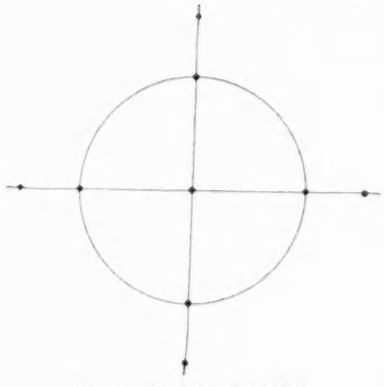


Fig. 2. WITNESS MARK.

eters, and taking 40 (the diameter of our pulley in this case) we follow the vertical line designated 40 down to its intersection with the horizontal line which is designated at the left 200 (which number represents our number of revolutions per minute), and from this point of intersection we follow the line diagonally downward and to the right until we come to the line of figures representing belt speed in hundreds of feet per minute, and we find it is nearly 2,100 feet. This last figure is not needed in this instance, but the diagram shows what it is, and it costs us nothing to note the speed. From this point we follow vertically downwards until we intersect the diagonal line representing 10 horse-power (numbered at the bottom of the diagram), and the figure at the left of this point of intersection shows that the belt must be 4 inches wide, nearly.

My own rule for belting is to consider that one square foot of single belt per second gives one horse-power, and according to this rule the horse-power in this case would be (by computation) 11.5 horse-power, and according to the table given in Jones & Laughlin's book such a belt would transmit 11.6 horse-power at that speed if running on pulleys of equal size. But Mr. Taylor has shown that it pays to have belts somewhat wider than they usually are, or rather to load them somewhat less heavily per inch of width; and in any event it is not the formula that is under discussion, but the diagram, and in constructing this it may be adapted to any desired formula.

In like manner, any other unknown factor in such a problem may be readily found, and one of the great beauties of such a diagram is the facility with which we can see when any particular limitation of the problem in hand is exceeded and can modify other factors accordingly.

The formula is given also, but the work is more quickly performed by the diagram. And the diagram never allows its mind to wander and to say "6 times 7 are 48," or "9's into 53, 5 times and 7 over."

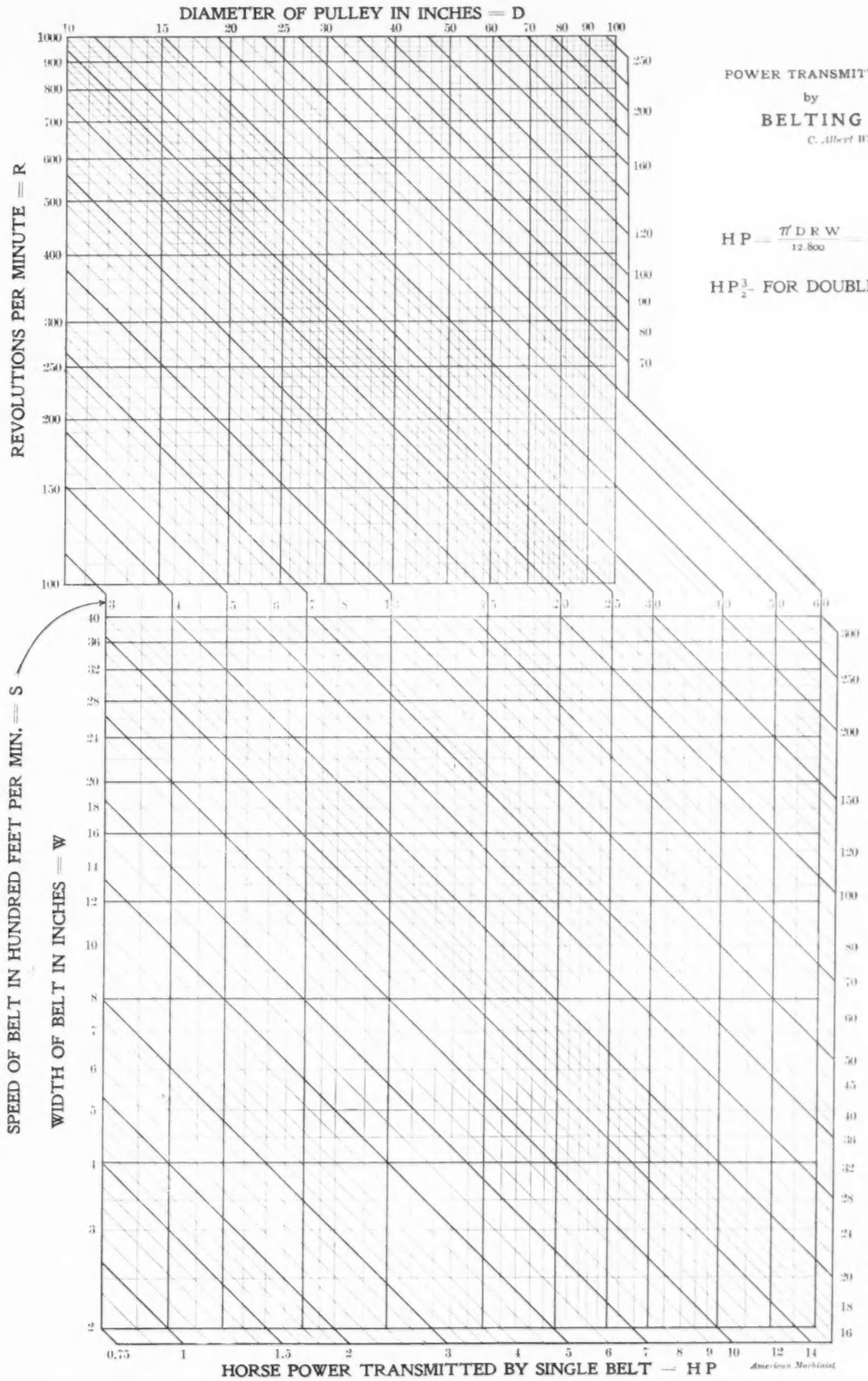
S. T. FREELAND.

▲ ▲ ▲

Coal-Handling Machinery.

A plant for transferring coal from railway cars into vessels, and which presents several interesting and novel details, has been in service for some time past at the Erie Railway Docks, of Cleveland, O. It was constructed by the Excelsior Iron Works Company, of Cleveland, from designs furnished by Mr. Timothy Young, who was associated with the constructors. The general principle adopted is very simple: A cylinder large enough to receive a coal car is mounted at each end of rails on which it is free to roll to and fro, under proper control. Within the cylinder, rails are laid upon which the car to be emptied is run, and this being securely locked, the cylinder is drawn forward to the head of the shutes and reversed so that the coal is discharged into the hoppers; the cylinder is then drawn back, the car coming again right end up by the time the track is reached upon which it is run off. The cylinder is 40 feet in length, 11 feet in diameter inside and 16 feet outside; it is strongly framed of steel, and is provided with openings of sufficient size for the coal to pass through. The rails of the tracks on which the coal is brought for shipment are 28 feet above the wharf level; the cylinder is therefore carried on a staging of such a height that the rails in the cylinder are at the same level as those of the track, and the space between this and the wharf is occupied by the operating machinery.

This consists of a horizontal steam cylinder 30 inches in diameter and 19 feet long, with pipes for admitting steam to each end, although in this case the apparatus is only single-acting, as the tracks on which the tipping cylinder rests are set on an incline in order that it may run back by gravity. On the end of the piston-rod of the steam cylinder is a cross-head to which are attached steel cables that control the movement of the tipping cylinder. A double cable is placed around each end of the latter, and these, after passing over sheaves, are taken to the cross-head. When


DIAMETER OF PULLEY IN INCHES = D
REVOLUTIONS PER MINUTE = R
SPEED OF BELT IN HUNDRED FEET PER MIN. = S
WIDTH OF BELT IN INCHES = W
HORSE POWER TRANSMITTED BY SINGLE BELT = H P
POWER TRANSMITTED
by
BELTING
C. Albert Wettengel
H P = π D R W / 12,800 = S W / 8
H P 3/2 FOR DOUBLE BELT
American Machinist

steam is admitted to the cylinder the motion of the piston operates the cables and draws the cylinder forward, reversing it at the same time. When released, it rolls back by gravity. In order to insure a uniform motion, rows of steel pins about 4 inches in diameter are fixed alongside the cylinder track, and fit into holes in the periphery of the cylinder near each end.

It is necessary to hold the car securely during the operation; this is effected by a system of clamps that move vertically, and when in place on the top of the car are held by locking ratchets; the movement of the clamps is entirely automatic, and they come into operation as soon as the cylinder begins to roll. They are not released until the cylinder has returned to its normal position and the car can be shifted from the cylinder. The coal shutes are used at an angle of 45 degrees, and are provided with doors to prevent the coal falling heavily and becoming broken. They are hung to the staging by steel ropes and can be shifted into any desired position with but little trouble. The movements of the apparatus are controlled from a small platform near one end of the cylinder path, from which the tipping machinery and the vessel alongside can be seen. Three men are required for operating the plant—an engineer and fireman, a man to work the rolling cylinder, and a third to control the shutes. It is stated that the capacity of this machine is 300 cars, or 7,500 tons per day of twenty-four hours. As may be supposed, the cost of handling is very low.

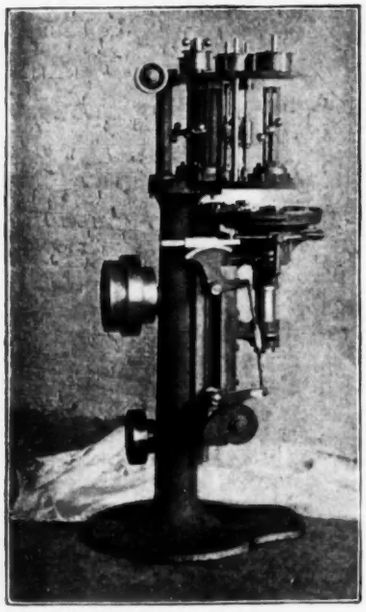


Fig. 205. WOODRUFF MFG. CO.'S CHAIN BLOCK DRILLER.

This is a case in which machinery does not cheapen the cost of the product to the consumer. That is not the fault of the machinery, however, but is due to causes which the economists and statesmen must deal with.

Cycle Tools—XXXI.

[CONCLUSION.]

Chain-Making.

Cycle chain manufacture is a very complex subject, embodying a great number of most interesting questions which have been variously answered in various chain shops. No attempt will be made at this time to go into details of chain-making. The side links of chains are almost invariably cut from sheet metal strips, usually with an automatic feed; an example is shown in Fig. 205, from the Western Wheel shops, Chicago. The holes are punched, and the best practice brings the variation inside of 0.001 inch, or 0.0005 inch each way from the derived center to center distance, which is as close as the best jig-drilling usually comes. There are no chains made which are a very close job; the best jig-drilling and best punching and best geometric or axial boring-tool guiding, all reach about the same limit of error, one-thousandth. The Indianapolis chain shop, which is one of the largest, uses, as I am informed, twenty-three of the Woodruff Manufacturing Company's automatic block-drilling machines, Fig. 205, in which the tools are axially guided, and the holes are successively drilled, bored with a single-point boring-tool and reamed; the blocks being carried on an automatically revolved and locked table. Whatever method of tool guiding is adopted, great care has to be used in keeping up tools to keep the variation limit inside of 0.001 inch. The Garvin Company builds a set of chain block

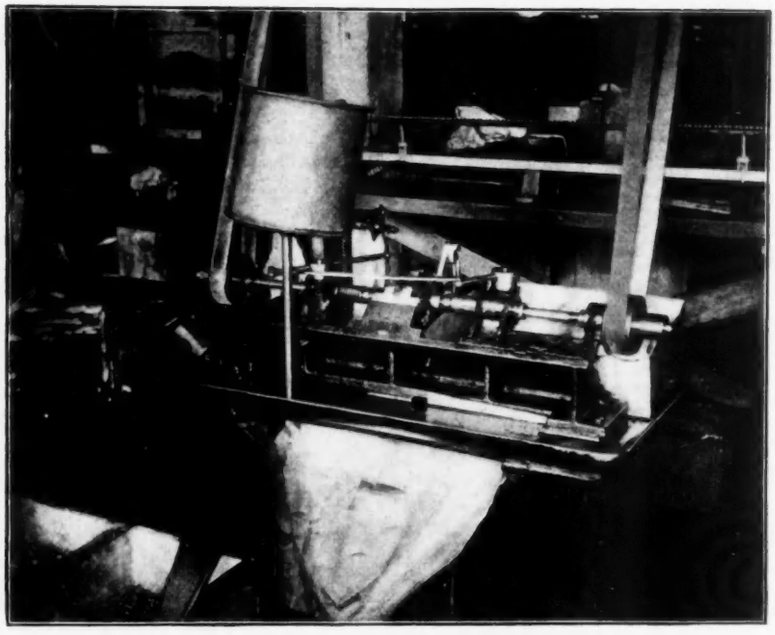


Fig. 206. GARVIN BLOCK REAMERS—YOST SHOP.

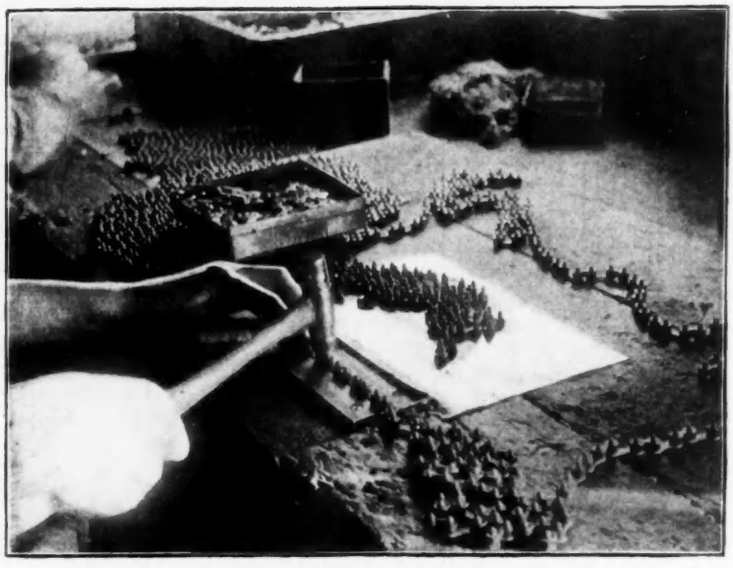


Fig. 207. HAND CHAIN ASSEMBLING—LOZIER SHOPS.

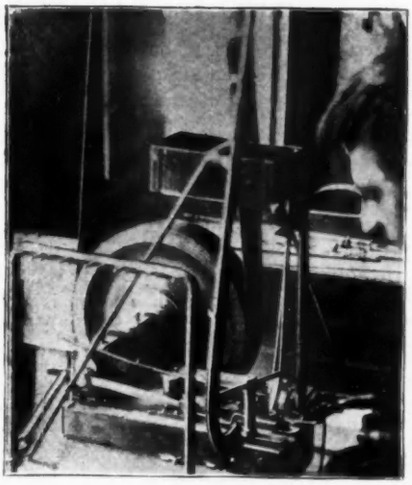


Fig. 208. AUTOMATIC BLOCK AND RIVET-ASSEMBLING MACHINE—WESTERN WHEEL SHOPS.

Fig. 204. AUTOMATIC CHAIN LINK CUTTING —WESTERN WHEEL SHOPS.

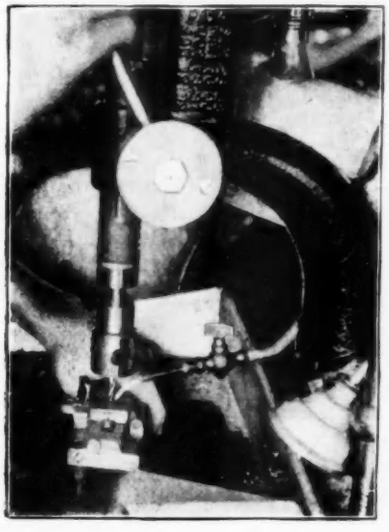


Fig. 210. LEAF JIGS, CHAIN BLOCKS —LOZIER SHOPS.

Fig. 209. BARNES' DRILLERS FOR CHAIN BLOCKS—LOZIER SHOPS.

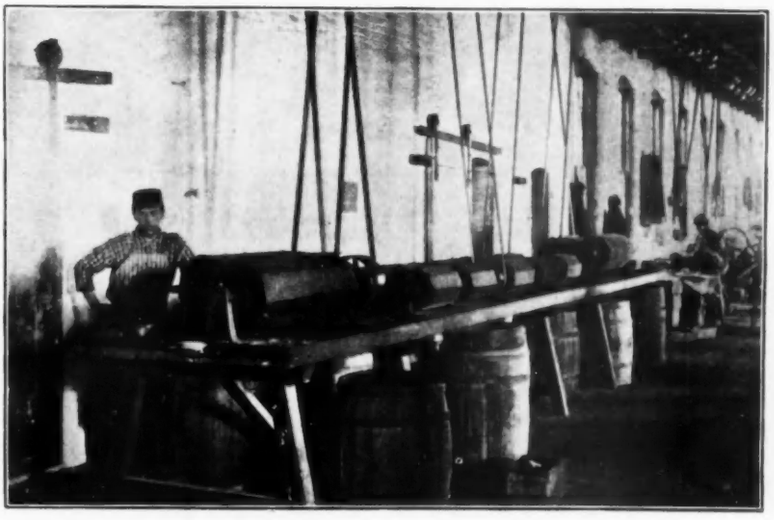


Fig. 212. WOODEN TUMBLERS—LOZIER SHOPS.

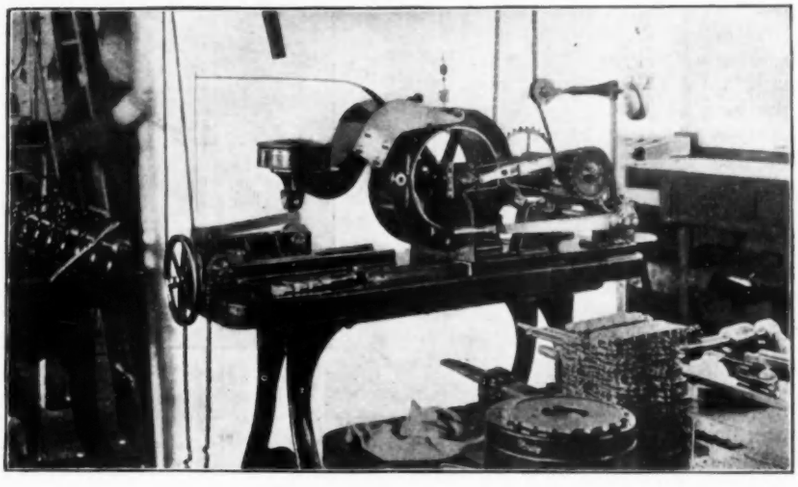


Fig. 214. COLUMBIA CHAIN-TESTING MACHINE.

tools comprising an automatic multi-spindle block driller, and a 2-spindle hand-fed block-reaming machine; the latter is shown in Fig. 206, from the Yost factory, Toledo, O. These machines of Garvin's are seen. Both are excellent tools; the Barnes friction disk drive makes tool breakage rare. It is shown in Figs. 209, 210, from the Lozier shops, where leaf jigs, armory pattern, are used for drilling

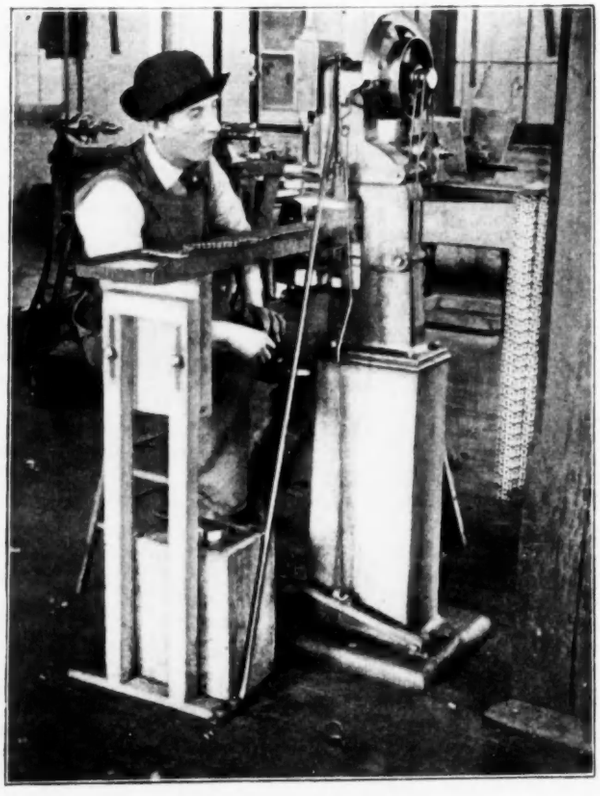


Fig. 211. RIVETING LOZIER CHAINS.

have axis-guided tools and can do close work, but, as they are commonly used, often show from three to five thousandths variation; the reamers follow the drilled holes, and if the drilling machines are urged, as they often are, and with dull drills at that, the axis-guiding is not effective. With sharp drills, and a graduated feed, giving a very slow drill start in the metal, the machines give good results.

The middle blocks are commonly cut from steel bars (drawn to shape) in "Lincoln" milling machines fitted with a double automatic fixture, which is sometimes made to carry two bars on each side of the gang of fifteen saws, thus cutting thirty-two blocks at each single stroke of the fixture carriage, or sixty-four blocks at each double stroke. If the saws are kept sharp the blocks come within a thousandth or so of uniform thickness. With dull saws and forced production the variation can be much more.

Chain parts are assembled by hand, as in Fig. 207, from the Lozier shops, or automatically in part, as in Fig. 208, from the Western Wheel shops, which shows a machine for assembling each link block with its two rivets.

Barnes or Slate drillers are most often used on chain work, although other makes

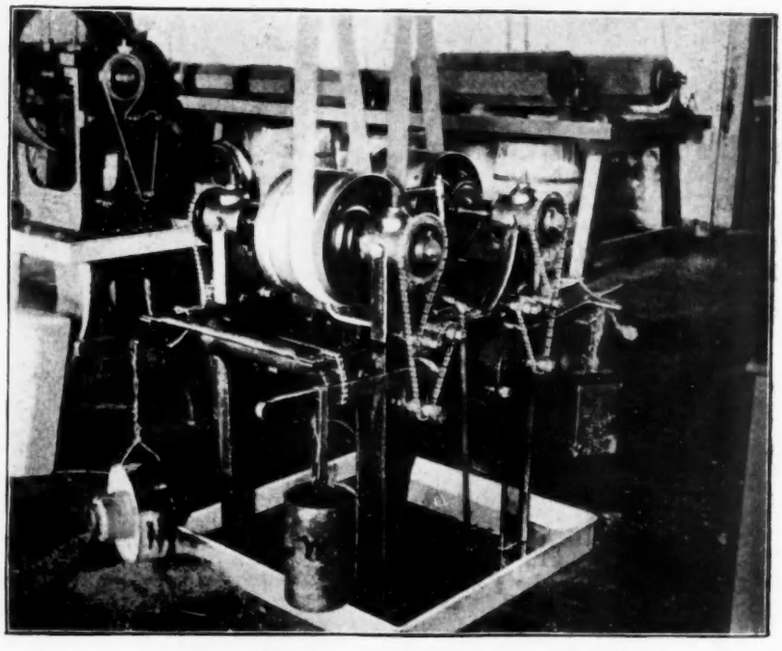


Fig. 213. LOZIER QUADRUPLE CHAIN JACKS.

chain blocks, with flooded lubrication of soap and water.

The Lozier factory makes a great point of chain construction, and makes a chain as nearly to uniform pitch, perhaps, as is produced anywhere. All the chain work is pieced at high prices, boys making from $8 to $10 and even $12 per week; inspection is rigid and constant, and the chain job has its own gang of tool makers, all the tools being made in exact duplicate, and spare bushes being constantly on hand for each jig-user; by this constant inspection and liberal tool-making the Lozier "Cleveland" chains are kept surprisingly close to pitch. Nothing is taken on trust, however; the inspection is constant, with severe penalties for work variations beyond the limit, and the whole Lozier chain job is watched closely.

Chain riveting is done mainly on Farrel Foundry "spinning" riveters, automatic, and on "Adt" reciprocating riveters. The "Adt" is shown at work in Fig. 211, from the Lozier shops. The perfection of the Lozier chain work is shown in the bunch of chain hanging from the rod at the right of Fig. 211, where they are seen to hang perfectly straight as they come from the riveter.

After riveting, the chains are in some cases so crooked that the first operation is straightening with a mallet, the short crooks being taken out by pounding; such chain-making needs no criticism. Commonly, however, the chains come from the riveting machine fairly straight, and with a total length variation in regulation 50-link chains of not more than $\frac{1}{32}$ to $\frac{1}{16}$ inch. This variation can easily reach ¼ inch, with work not very carefully looked after, and never, I think, falls below $\frac{1}{32}$ inch in total chain length. Fig. 212 shows the Lozier wooden chain tumblers. Other forms are used; the Lozier tumbling finish is exceptionally good, and the tumblers are shown for that reason.

The final operation is to "jack" or stretch the chain. The Lozier "jack" is shown in Fig. 213. The lever *L* is pivoted at the rear, carries the lower sprocket *R* and the weight *W*, by which the chain is loaded during the "jacking." This machine handles four chains at once, with an acute re-entrant angle of travel, very clearly shown, which is of importance.

Fig. 214 shows the very elaborate chain-testing machine used by the Columbia. This combines a Prony brake and an automatically traversing wedge-brake-weight-controlling mechanism, by means of which the strain on the chain is gradually increased to the maximum, the whole being automatic in operation. The Columbia test is very severe, and apparently nearer the endurance limit than any other observed by me, as chain failure seemed more frequent. I hope at a future time to more fully describe this machine.

This installment, XXX, closes the series of Bicycle Tool articles. Subsequent information in this line will be given in separate papers under individual titles, as it is unquestionably an error to continue any topic through a long series of papers under the same heading. The vast number of metal workers employed in the industry warrants a presentation of interesting novelties and sound practice, and these pages will continue to give the best and newest information obtainable concerning the art of cycle-making along with other records of shop practice.

HUGH DOLNAR.

[THE END.]

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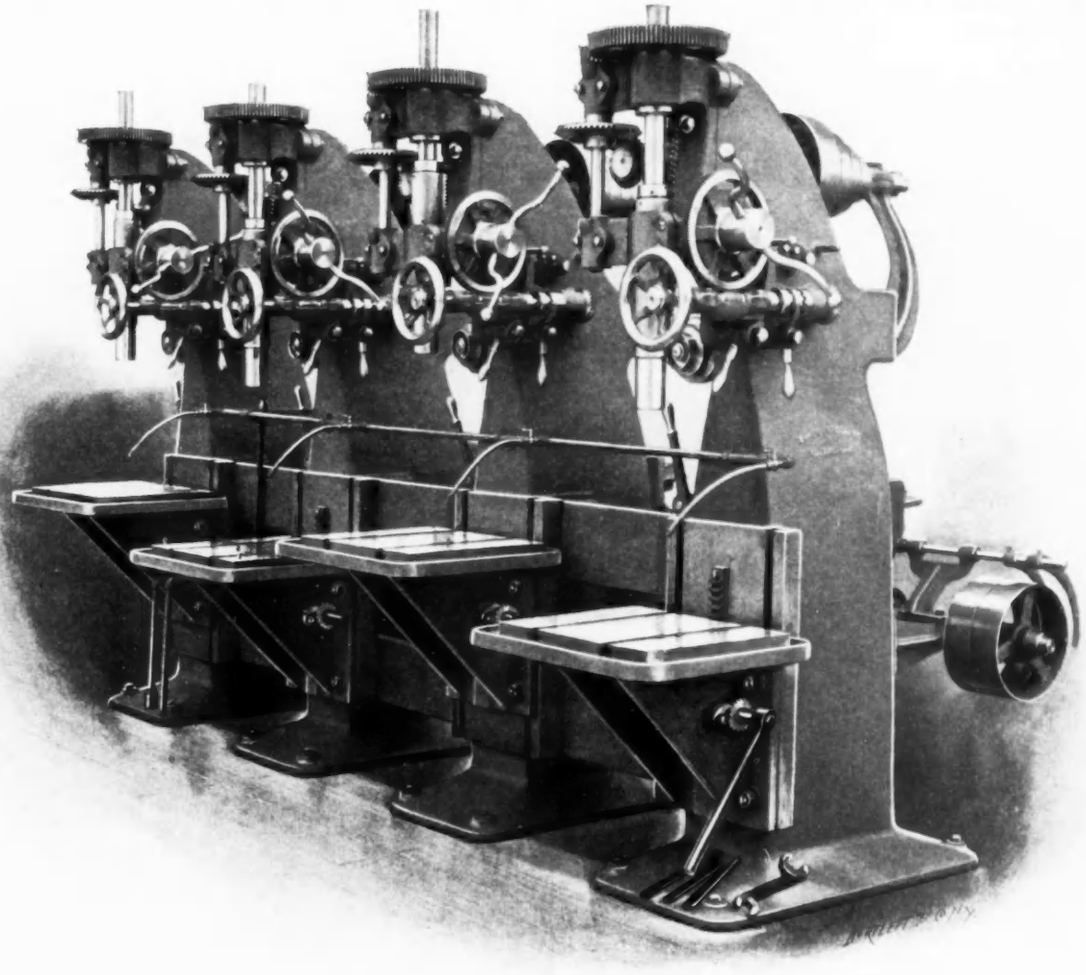
Multiple-Spindle Drill Press.

In our issue of January 10, 1895, we illustrated and described a multiple-spindle drilling machine which was designed especially for such work as drilling the crank hangers and other drop-forged parts of bicycle frames, and we give with this issue an engraving of a machine which is the outgrowth of and the successor to the machine first referred to.



MULTIPLE-SPINDLE DRILL PRESS.

The engraving makes its proportions and construction so clear that little need be said by way of description, except that each individual frame is cast in a single piece, and as many of these are yoked together as may be desired, the whole forming, in one sense, one machine, but in another sense a separate machine for each spindle, since each spindle is separately driven and can be separately handled.

Each spindle has power feed, and also feeds by lever, hand wheel and worm; has automatic stop and quick return. There are four changes of speed and three of feed. The spindles are 2⅛ inches diameter, are made of crucible steel, and have ball thrust bearings on sleeve. They are counterbalanced by weights hung on the inside of the main frame.

The tables have an upright bearing on main frame 19 inches long by 16 in width, and are clamped in any desired position by means of four heavy bolts. The tables are raised and lowered by means of a lever operating a shaft with a pinion, which engages with a rack on face of main frame. A ratchet and pawl lock the pinion shaft.

The countershafts for each machine are on the main frames, and are controlled by the hand levers at side of each frame. The countershafts can be belted direct from the main shaft, and the machines will stand in line with same.

An oil pump of approved design is furnished, fitted and connected, with each gang of drills, and machines are piped

for conveying the lubricant to the drill. Almond's flexible metal tubes are furnished with each spindle. These tubes remain rigidly in any position where placed without support, and will not deteriorate by the use of oil or other lubricants. A suitable oil tank is also furnished with each gang of drills, together with all necessary piping to and from the pump.

The spindles are 35 inches apart, have 8-inch vertical movement, and the vertical movement of the tables is 12 inches. Weight of machine, 2,200 pounds per spindle.

Some of the drilling records made by this machine are remarkable. For instance, on a "regular run," solid forged crank hangers, with a hole 1 15-16 inches diameter and 3⅜ inches long, have been drilled at the rate of one in six minutes and twenty seconds. Solid forged crank hangers, with a hole 1½ inches diameter by 3¼ inches long, have been drilled in three minutes. Both these records were made by manufacturers using the machine.

The machine is built by Baker Brothers, of Toledo, O., and was designed by their superintendent, Mr. L. H. Colburn.

▲ ▲ ▲

Exhibit of Competing Goods.

They are holding now in England an exhibition of a somewhat unique character, called an "Exhibit of Colonial Samples," the idea of the affair being that samples are sent from England's various colonies, of goods manufactured in other countries which compete successfully in those colonies with similar goods made in England. The first division or section of this exhibit is now being held at the Imperial Institute, in London, and is restricted to an exhibit from the West Indian Colonies, the reason being that there was no available space sufficient for the exhibit from all the colonies together and yet have the exhibit in a convenient location.

The "Engineer," of London, in speaking of the exhibit, confines itself mainly to those articles which come more particularly in the class which pertains more or less to engineering work, and refers to a number of implements made in this country, some of which it condemns as almost worthless, while to others it accords high praise. Our American locks are particularly specified as being excellent; but a curious mistake seems to be made in criticising shovels of American make, which are declared to bristle with rivets, and special objection is made to a rivet which passes transversely through the handle below the grip. This is evidently taken to indicate that the handle is patched up from various pieces of wood, and it is roundly condemned on that account by our contemporary and by British shovel manufacturers. We all know, however, that these handles are in reality made of one piece of wood, the rivet being put through simply to strengthen and prevent splitting.

This aside, however, the fact remains that this exhibit of samples of competing goods, with particulars regarding them, including the prices at which they are furnished in the colonies, is certainly an instructive one, and might well be followed in this country. Our American Association of Manufacturers might do well to examine into this matter, and see what might be done for the enlightenment of American manufacturers in some such way.

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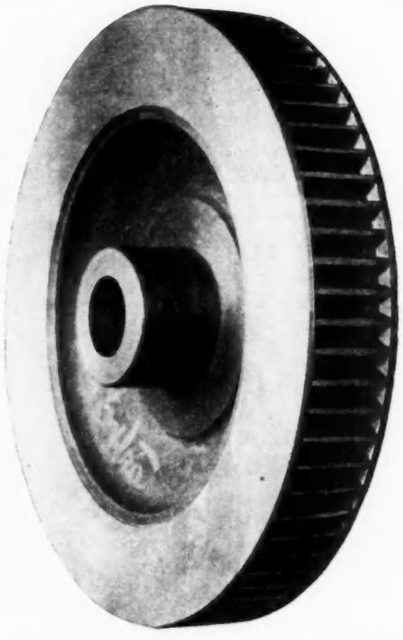
The Largest Rawhide Gear.

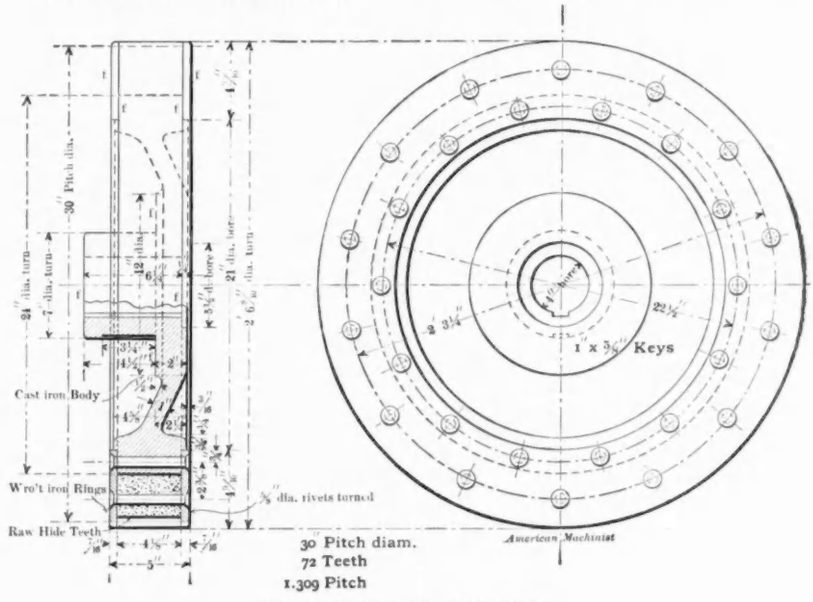
We herewith reproduce a photo of a large rawhide gear with drawing showing the details of construction.



THE LARGEST RAWHIDE GEAR.

The gear is probably the largest rawhide gear ever made, and certainly the largest ever made of complete disks of raw hide, instead of segments, which are sometimes employed. The process employed by the makers of this wheel for curing the hides is one of elimination and compression, and the resulting stock is extremely thin, so that the making of such a wheel of complete disks means the cutting-up of a large number of hides. The wheel consists of a cast-iron body with plates of wrought iron on each side holding the rings of raw hide between them, all being held together by 28 rivets ⅝-inch diameter, turned and fitted. The flanges come out to the full diameter of the teeth. The dimensions of the gear are: Pitch diameter, 30 inches; number of teeth, 72; circumferential pitch, 1.309 inches; face of teeth between flanges, 4⅛ inches; bore, 4 inches. Pinions of raw hide are made in large numbers by the makers of this gear, and when for ordinary purposes and of common sizes, they are made of all raw hide, no metal whatever being used for hubs or flanges, or for anything but the rivets. This practice has, of course, been arrived at by the "survival of the fittest" process.

The gear shown is made for one of their customers by the New Process Raw Hide Co., of Syracuse, N. Y.



30 Pitch diam.
72 Teeth
1.309 Pitch

DETAILS OF RAWHIDE GEAR.

A diminutive bicycle has been made, not by "it is said," but by Joseph Figarotto, an employé of the Keystone Watch-Case Co., of Philadelphia. The bicycle is small enough to easily go in the vest pocket, and is perfect and in perfect proportion in all its parts, having pneumatic tires, bell, lantern, rat-trap pedals, and all the latest improvements. The dimensions in inches are given as follows: Frame, 1⅛; wheel base, 2⅛; wheel, 1¼; tires, ⅛; cranks, ¼; tread, ½; chain, 1-32; gear, 2⅜.

A Variable Speed Countershaft.

No mechanic of the shops needs to be told of the desirability of running every machine at the precise speed that will enable it to accomplish the best results, either in quality or in quantity. It is scarcely less desirable, and is, in fact, a condition implied, that it should be possible at any time to change the running speed of machines as the conditions of operation vary.

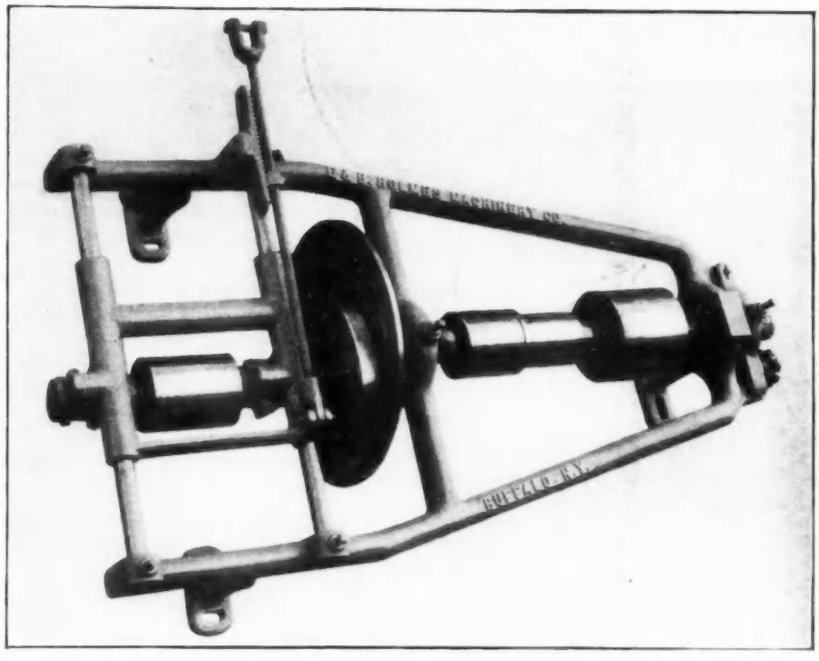


Fig. 1. A VARIABLE SPEED COUNTERSHAFT.

most necessary to the success of the horseless vehicle, which we are all waiting to welcome. No motor yet devised can operate a road wagon at all required speeds without some means of changing decidedly the speed relation of the motor shaft to that of the carrying or propelling wheels.

The ideal variable speed would have no slip, but would maintain a positive relation of the driver to the driven, as with toothed gearing, and at the same time the speed would be variable at will by imperceptible gradations all the way from the fastest to the slowest driven speed. Such a variable speed has been striven for by the most ingenious and persevering of mechanics for generations, and there is still no sign of its coming. If it will ever be accomplished no man may say, but all know well enough that it would be a prize to the mechanical world.

In this connection we find pleasure in presenting to our readers the variable speed countershaft exhibited in the accompanying illustrations. It may be said that it is still not the ideal variable speed device, in that its drive is not positive, but neither is the drive of a belt, which is the accepted means of power transmission for perhaps three-quarters of all our machinery.

This device consists essentially of two disks, usually of different diameters and with faces of different material, one face inclining slightly to the other, so that contact between the faces occurs at or near one edge of the smaller disk. Means are provided for moving the smaller disk across the face of the larger one, and, the larger being the driver, and running at a constant speed, the speed of revolution of the smaller disk, and of the pulley carried upon the same spindle with it, is varied by the change of position. If the driving contact is carried toward the center of the driving disk the speed of the driven spindle is reduced, and if the contact is made to take place farther from the center of the driving disk the speed of the driven is increased. As the shaft of the driving disk runs in fixed bearings it may be driven by any suitable means. The driven disk and its shaft being movable, the power may best be taken from it by means of a belt, the line of movement for change of speed being at right angles to the pull of the belt, so that the belt tension is scarcely affected by the lateral movement.

The applications of this device are so various that no single illustration can give any idea of them. The half-tone shows a special overhead countershaft that was devised for a case where two different parts of a large wood-working machine were to be driven independently of each other, one part running at a uniform speed and the other part at a variable speed. The frame is bolted to the ceiling by the feet shown, so that principally the under side of the arrangement is seen on the paper. The pulley at the extreme right drives the principal part of the machine, a belt going down vertically from it to the machine.

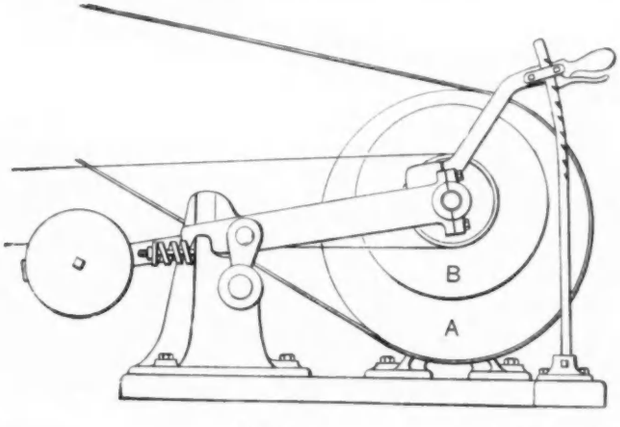


Fig. 2.

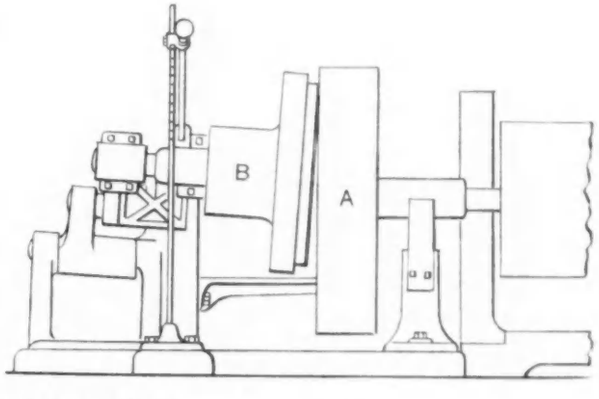


Fig. 3.

VARIABLE FEED FOR WOOD PLANER.

Sometimes a machine might profitably be run faster than its fixed or normal speed, and sometimes a reduction of speed is imperative. Anything that will enable us to accomplish this is desirable, and if the speed of the machine can be changed without stoppage, and by minute gradations rather than by great and sudden differences, so much the better. Sometimes it is not the speed of the machine itself, but of the feed or some subsidiary movement that it is desirable to change. A satisfactory variable speed is one of the things

Next to this pulley are the tight and loose pulleys by which the spindle is driven, the loose pulley being considerably smaller in diameter that the tight pulley, as is quite common with wood machinery. The driving belt, if horizontal, will straddle the side member of the bracket, or one belt will go above and the other below it. At the end of the spindle is the driving disk, which is turned all over and balanced. This countershaft is run preferably at high speed, as then the pressure against the disk may be very light and at the same time the slip will be inappreciable. The movable disk and the variable speed driving pulley are carried by the sliding bracket. A shipper lever, not shown, is hinged at the ceiling and joined into the open fork at the end of the rod. The lever hangs down within easy reach of the hand. A side spring is provided upon it to hold the toothed piece upon the rod in the teeth of the fixed rack. To change the speed, a side movement of the shipper lever disengages the teeth from the rack, and then the carriage may be slid in or out, and the speed reduced or increased as desired.

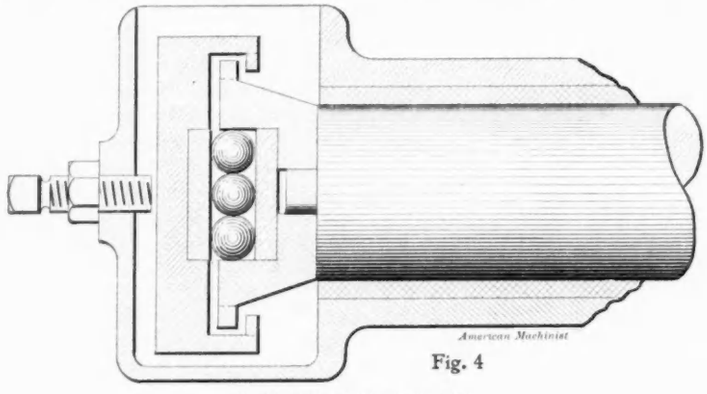


Fig. 4

BALL-THRUST BEARING.

Figs. 2 and 3 show in a rough way the application of the variable speed to the feed of a wood-planing machine, for which purpose it was first devised, and has been used several years. In this case *A* and *B* are both pulleys, as well as forming part of the friction drive. This sketch does not show a very important feature, which is the ball thrust bearing sketched in Fig. 4. The valuable service of the ball bearing is realized in this application as much as in any place where it has ever been tried. Seven balls are used, one in the center and six around it, and only flat surfaces are used for bearings.

This variable speed has been used for years, as was said, in the line of wood planers and other machines, and has been applied in different shops to the driving of iron-working tools, lathes, planers, shapers, drills, boring mills, etc., with most satisfactory results. It has been gradually improved in detail and in workmanship. While the driving disk is of iron, turned all over and ground on the face, the driven disk is not properly a disk at all, but a ring of end grain wood held in a dovetailed circular groove by a beveled ring of metal. The wood is treated with oil or wax, so that all the pores are filled, and as the two friction surfaces run always so nearly in the same direction, the rubbing is slight and the wear is inappreciable.

The countershaft is made by the E. & B. Holmes Machinery Company, Buffalo, N. Y.

ELECTRICAL MACHINERY.

Series Reversing Motor and the Switch and Wiring Connections Used Therewith.

BY WM. BAXTER, JR.

Electric motors, like steam engines, are very often used for purposes where it is necessary to reverse the direction of rotation, and when this is the case a switch has to be used that is very different from that required when the motion is always in the same direction. The construction of the switch for a reversing motor must be somewhat modified for the various types of winding; that is, the switch that would be suitable for a shunt-wound motor would not answer for a series machine.

The series type of motor is the one that is used the most for cases where the direction of rotation has to be reversed; therefore it will be explained first.

The accompanying diagram shows the general arrangement of the circuits, and the principle upon which the switch is constructed, and also other details which will be explained further on. In this diagram, the current coming from the source of supply enters the system through the wire *P*, and leaves by the wire *N*. The switch is, as a rule, made in the form of a cylinder, upon the surface of which there are metal plates that are raised considerably higher than the remainder of the surface. These plates are shown in the diagram above the words "forward" and "reverse." The cylinder is provided with a spindle, to the upper end of which a handle is attached, so that it may be moved around in either direction. This spindle is held in bearings that are secured to a frame that forms part of the switch casing. Upon this frame a series of contacts are fastened, as indicated in the diagram along the line of dots marked 6, 5, 4, 3, 2, 1, *B*, *N*, *G*, *F*, *C*. These contacts are so arranged that they may press upon the plates on the surface of the cylinder. In order to make the explanation as clear as possible it will be well to say that these plates, which are shown on both sides of the row of contacts, are of the shape and in the position they occupy on the surface of the cylinder; that is, if the surface were rolled out flat it would look as shown, or if the paper were rolled up into a cylindrical form large enough to allow a space between the edges of the plates *D* and *J* it would be a true representation of the cylinder surface. As will be noticed, the plates *D* and *J* are made with their front edges in the form of a series of steps; the object of this is to provide means for starting the motor easily, and also in some cases to regulate the speed. It will also be noticed that the two plates *H*, *E* on the forward side are replaced by four, namely, *K*, *S*, *L*, *T*, on the reverse side. The reason for this difference is that these plates are used for reversing the motor.

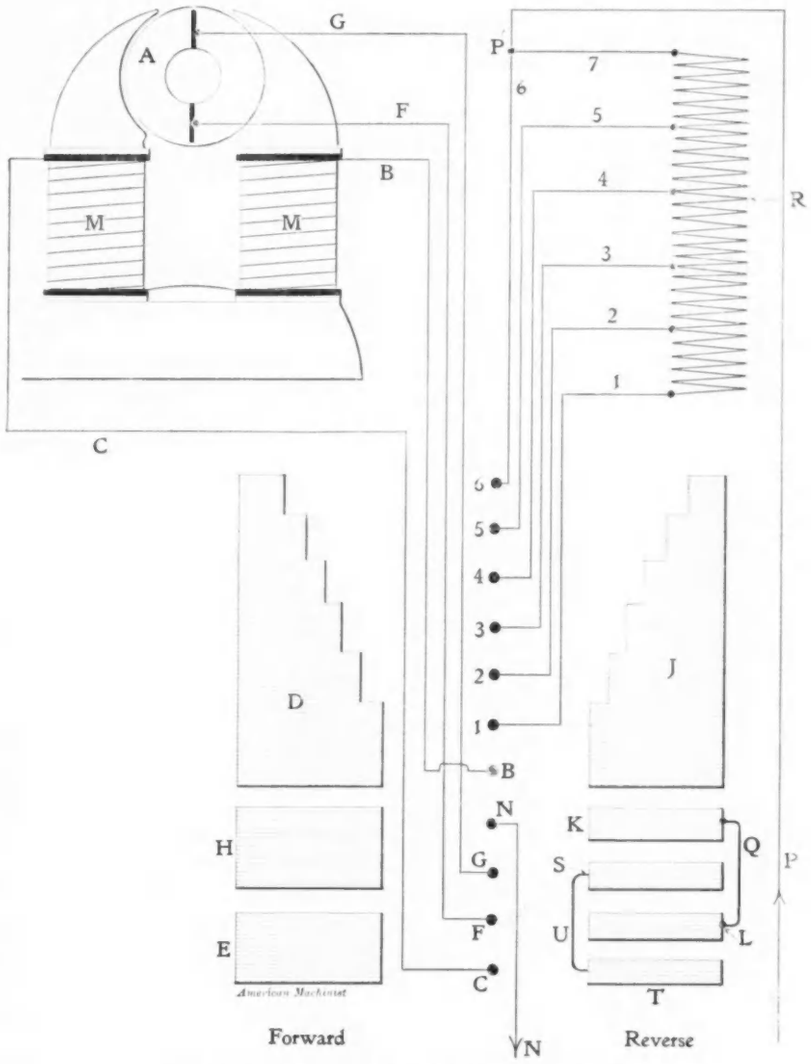
The handle placed on the end of the cylinder spindle moves over a dial, which is provided with points to indicate the position of the cylinder plates with reference to the row of stationary contacts, and in most cases there is a notched wheel on the spindle, and a pawl so placed that it may fall into the notches as the wheel revolves. This latter arrangement is the best one, as it enables the operator to tell when the switch is in the right position by the feeling and without looking at the dial. The notches or points are located so as to agree with the steps on the edge of the plates *D* and *J*.

The general operation of the switch is as follows: Suppose it is desired to run the motor in the forward direction; then the handle is turned so that the plates on the side marked forward will move over the central row of stationary contacts. When the handle is moved to the first point, the lower end of the plate *D* will pass over the contacts 1 and *B*, plate *H* will cover *N* and *G*, and plate *E* will cover *F* and *C*. With these connections the path of the current will be as follows: From wire *P* it will pass at P^1 to wire 7, and then will go through the rheostat resistance *R*, from the end of which it will pass by wire 1 to contact 1, and as this is connected with *B* by the plate *D*, the circuit will be complete as far as the wire *B*. From this wire the current will go to the motor field magnet coils *M*, and return to the switch by way of the wire *C* to contact *C*. As

this contact is connected with *F* by the plate *E*, the current will pass to wire *F*, and thus to the lower brush, and through the armature to the upper brush and wire *G*. Through wire *G* the current will pass to the contact *G* of the switch, and through the plate *H* to *N*, and back to the source of supply.

When the switch handle is turned to the second point, the plate *D* will connect the contacts *B*, 1, 2, and then the current will not go through the whole of the resistance *R*, but only as far as wire 2. The second step, therefore, cuts out of the circuit the section of the resistance between 1 and 2. When the handle is moved to the third point, the plate *D* will connect the contacts *B*, 1, 2, 3, and the current will go through the resistance as far as wire 3, and thus two sections will be cut out. The movement to the fourth point connects, through plate *D*, *B*, 1, 2, 3, 4, and cuts out three sections of the resistance. In the same way, the fifth point cuts out four sections, adding contact 5 to those already connected with each other, and the movement to the sixth and last point cuts out all the resistance.

In the foregoing explanation, it will be noticed that the current enters the field magnet coils by the wire *B*, and returns by wire *C*, and enters the armature by wire *F*, returning by wire *G*. To reverse the direction of rotation it is necessary to reverse the current, either through the field or the armature, so that the direction of flow of one with respect to the other may be changed. It makes no difference in which one the current is reversed, but it must not be reversed in both, for if it were, the direction of flow of one with respect to the other would not be changed. In the diagram the current will be reversed through the armature, as will be seen by supposing that the switch handle is turned so as to move the plates on the reverse side over the row of contacts. Under these conditions the plate *J* will connect contacts *B* and 1, and the current coming from *P*, through the rheostat *R*, will pass to the wire *B*, and enter the field magnet coils through the same end as was the case when the switch was turned for the forward motion. But when the current returns from the field coils by the wire *C*, it will not go to *F*, as it did then; but as the plate *T*, which now covers the contact *C*, is connected with plate *S* by the wire *U*, it will pass to wire *G*, as the *G* contact is in connection with plate *S*. When the switch was turned for the forward motion the current entered the armature by the wire *F*, but now it enters by the wire *G*; therefore it passes through the armature in the opposite direction.



SERIES MOTOR AND REVERSING SWITCH.

The office of the plate *I* is the same as that of the plate *D*; that is, to cut out the sections of the resistance in succession as the switch is moved around from point to point.

In switches of this class it is very necessary that the cylinder should be moved far enough at each step to enable the plates to pass well over the contacts. If this is not done, the edges of the stationary contacts may just lap over the edges of the plates on the cylinder enough to make an imperfect contact, and thereby cause sparking that would soon prove destructive. It is on this account that the handle is moved by successive steps, and that a dial, or a notched wheel, is provided to guide the operator in the movement of the handle.

These switches are generally used only for the purpose of reversing the direction of rotation of a motor, but they can also be used to vary the velocity—that is, to reduce it—but their use for this purpose is not to be recommended, as it is an unnecessary waste of energy, since better means can be provided for accomplishing this result.

When the switch is to be used simply for the purpose of reversing, the resistance of the rheostat *R* may be of light current-carrying capacity, as it will only be traversed by the current for short intervals of time, and therefore will not become overheated; but if it is also to be used as a means of reducing the speed, the capacity will have to be greatly increased.

When a motor is started with a switch of this kind, the movement from step to step should be made in as rapid succession as possible without causing the speed to accelerate by a series of jerks. The object of this quick start is to avoid unnecessary heating of the rheostat. In stopping, the handle should be turned back all the way to the starting-point, as rapidly as possible, so that the spark produced when the cylinder plates pass off of the stationary contacts may be of short duration and consequently not very destructive.

If the switch is also used to reduce the speed, it will be necessary, in most cases, to move the handle back step by step; but when that is the case, the plates *D*, *J* are replaced by a number of separate ones, and extra contacts are introduced between the stationary contacts 1, 2, 3, etc. The object of this is to reduce the spark by

breaking the circuit at several points when the plates pass off of the stationary contacts. The best way, however, to reduce the velocity is by the commutation of the field coils.

▲ ▲ ▲

Additional Tests of Power Absorbed by Electrically-driven Machine Tools at the Baldwin Locomotive Works.

TESTS MADE FOR THE "AMERICAN MACHINIST" BY C. W. PIKE, OF THE FALKENAU ENGINEERING CO.

Three-spindle Drilling Machine.

Bement, Miles & Co., makers; length, 21 feet; drilling in wrought iron with soap and oil; 86 revolutions per minute; 6-kilowatt motor:

Readings.	A.	V.	Elect. H. P.
Motor only	5.0	240	1.6
Motor and countershaft	6.5	240	2.1
Motor, countershaft and idle machine	8.0	246	2.6
Feed, .84 inch per minute—			
One ⅞-inch drill, { ½ / ⅞ again	11.0 / 11.0	245 ½ / 244 ⅞	3.6
Two ⅞-inch drills, { ½ / ⅞ again	13.0 / 12.5	242 ½ / 246 ⅞	4.1
Three ⅞-inch drills, { ½ / ⅞ again	15.0 / 15.0	242 ½ / 244 ⅞	4.8

Same machine as last, doing same character of work, but with larger drills, representing the maximum work for which the machine was designed; 78 revolutions per minute:

Readings.	A.	V.	Elect. H. P.
Motor only	5.0	240	1.6
Motor and countershaft	6.5	240	2.1
Motor, countershaft and idle machine	8.0	246	2.6
Feed, 4⅝ inch per minute, three 2-inch drills	25.4	235	8.0

Two-spindle Drilling Machine.

E. W. Harrington & Sons, makers; reach, 22 feet; drilling in wrought iron with soda water; 80 revolutions per minute; 4-kilowatt Gibbs motor:

Readings.	A.	V.	Elect. H. P.
Motor only	3.0	242	.97
Motor and countershaft	3.5	240	1.1
Motor, countershaft and idle machine	4.5	240	1.45
Feed, 5/16 inch per minute—			
Using one 1-inch drill	8.5	240	2.7
" " 1¼ "	11 5	240	3.7
" both drills	16.0	240	5.15

Radial Drilling Machine.

Bement, Miles & Co., makers; 42-inch arm; drilling in wrought iron with soda water; 42 revolutions per minute; machine not working to full capacity on account of feed gearing being out of order; 4-kilowatt Gibbs motor:

Readings.	A.	V.	Elect. H. P.
Motor only	2.5	240	.8
Motor and countershaft	3.0	240	.96
Motor, countershaft and idle machine	3.5	240	1.1
Feed, ¼ inch per minute, 2-inch drill	6.5	240	2.1

Vertical Boring and Turning Mill.

Wm. Sellers & Co., makers; table, 4 feet 6 inches diameter; one tool head; boring cast-steel driver tire, 3 feet 6 inches diameter; speed, 8 revolutions per minute; 4-kilowatt Gibbs motor:

Readings.	A.	V.	Elect. H. P.
Motor only	5.5	240	1.75
Motor and countershaft	6.5	240	2.1
Motor, countershaft and idle machine	8.0	238	2.4
Depth of cut, ⅛ inch; feed, 1/16 inch	15.0	240	4.6

Vertical Boring and Turning Mill.

Baldwin Locomotive Works, makers; table, 5 feet 6 inches diameter; one tool head; boring cast-iron driver hub; 6-kilowatt Gibbs motor:

Readings.	A.	V.	Elect. H. P.
Motor only	4.5	240	1.4
Motor and countershaft	5.0	240	1.6
Motor, countershaft and idle machine	7.5	240	2.4
Depth of cut, ½ inch; feed, 1/16 inch at 3 inches from center	13.0	240	4.2
Depth of cut, ½ inch; feed, 1/16 inch at 7 inches from center	15.0	240	4.8

Lathe.

Bement, Miles & Co., makers; swing, 90 inches; two tool heads, both cutting; turning cast-steel driving wheels, 5 feet 7⅛ inches diameter; one-half revolution per minute; no lubricant; 6-kilowatt Gibbs motor:

Readings.	A.	V.	Elect. H. P.
Motor only	4.0	240	1.30
Motor and countershaft	4.5	238	1.43
Motor, countershaft and idle machine	6.5	240	2.10
Depth of cut, ½ inch; feed, 3/32 inch, heavy cut	20.0	238	6.38

Planer.

Bement, Miles & Co., makers; 24 inches between housings; 13-foot table; two tool heads, both cutting; planing steel connecting rod; no lubricant; 9-kilowatt Gibbs motor, shunt-wound:

Readings.	A.	V.	Elect. H. P.
Motor only	4.5	248	1.5
Motor and countershaft	6.0	244	1.95
Motor, countershaft and idle machine—			
Forward, 18 ft. per min.	6.5	244	2.1
During reversal	60.0	242	19.5
Backward, 60 ft. per min.	20.0	242	6.5
Depth of cut, ¼ inch; feed, ⅛ inch	25.0	240	8.0

Remarks—The enormous current at reversal lasts but a few seconds, and then quickly and quite steadily falls to the normal value for the backward run.

Planer.

Wm. Sellers & Co., makers; 36 inches between housings; 18-foot table; belt reversal; two tool heads, both cutting; planing wrought iron with water; 14-kilowatt Gibbs motor, shunt-wound:

Readings.	A.	V.	Elect. H. P.
Motor only	7.5	241	2.4
Motor and countershaft	10.0	238	3.2
Motor, countershaft and idle machine—			
Forward, 20 ft. per min.	12.0	240	3.9
During reversal	70.0	236	22.1
Backward, 80 ft. per min.	15.0	240	4.7
Depth of cut, 1 inch; feed, ½ inch	53.0	236	16.7

Planer.

Wm. Sellers & Co., makers; 56 inches between housings; 35-foot table; quick-return pattern, with clutch reversal; forward speed, 18 feet 6 inches per minute; return speed, 111 feet per minute; two tool heads, both cutting; planing wrought-iron locomotive frames with water; 20-horse-power U. S. motor, shunt-wound:

Readings.	A.	V.	Elect. H. P.
Motor only	5.0	238	1.6
Motor and countershaft	15.0	230	4.6
Motor, countershaft and idle machine—			
Forward	22.5	236	7.1
During reversal	65.0	228	19.8
Backward	40.0	240	12.7
Depth of cut, ⅛ inch; feed, 1/16 inch	55.0	236	13.0
Depth of cut, ⅜ inch feed, 1/16 inch	60.0	228	13.7

Planer.

Wm. Sellers & Co., makers; 56 inches between housings; 24-foot table; shifting belt reversal; forward speed, 19 feet per minute; return speed, 70 feet per minute; two tool heads, both cutting; planing wrought iron with water; 18-kilowatt Gibbs motor, shunt-wound:

Readings.	A.	V.	Elect. H. P.
Motor only	10.2	237.9	3.25
Motor and countershaft	14.0	240.0	4.56
Motor, countershaft and idle machine—			
Forward	15.0	240.0	4.8
During reversal	100.0	232.0	31.1
Backward	23.0	232.0	7.15
Depth of cut, ⅜ inch; feed, 1/16 inch, tool just starting to cut {	70.0 / 75.0	228.0 / 236.0	16.0 / 17.7
Depth of cut, ⅜ inch; feed, 3/16 inch, after the tool gets well into the work {	60.0 / 65.0	.... / ...	.... / ....

Remarks—This and the previous test give an instructive comparison between the action of the shifting belt and clutch reversal. The clutch planer also shows an unusually high percentage of power applied to actual cutting, namely, 80 per cent. of the entire power absorbed for the cutting stroke, while the belt shifting planer of approximately the same size shows but 60 per cent.

Slotting Machine.

Wm. Sellers & Co., makers; diameter of table, 40 inches; maximum stroke of tool, 15 inches; cutting wrought iron with water; 18 strokes per minute; 6-kilowatt Gibbs motor, shunt-wound:

Downward stroke.....22½ ft. per min.
Return stroke.....67½ " "

Readings.	A.	V.	Elect. H. P.
Motor only	4.5	240	1.45
Motor and countershaft	5.5	242	1.8
Motor, countershaft and idle machine—			
Downward stroke	7.0	238	2.2
Return "	7.0	238	2.2
Depth of cut, ½ inch; feed 3/16 inch, heavy cut	23.0	238	7.3

Double-Head Locomotive Frame-Slotting Machine.

Bement, Miles & Co., makers; width between housings, 30 inches; length, 24 feet; slotting two wrought-iron locomotive frames with water; length of stroke, 9 inches; 15½ strokes per minute; maximum stroke, 16 inches; separate motor to each tool; readings are for one motor only; 9-kilowatt Gibbs motor, shunt-wound:

Cutting speed.....21 ft. per min.
Return speed.....61 " "

Readings.	A.	V.	Elect. H. P.
Motor only (1)	4.5	248	1.5
Motor and countershaft (1)	6.0	240	1.9
Motor, countershaft and idle machine—			
Downward stroke	7.0	237	2.2
Upward "	7.0	237	2.2
Depth of cut, ½ inch; feed, 1/16 inch	28.0	238	8.9
Depth of cut, ½ inch; feed, 1/16 inch, another reading	25.0	239	8.

Double-Head Frame-Slotting Machine.

Width between housings 4 feet; length, 48 feet; slotting wrought-iron locomotive frames; separate motor to each tool; readings for one motor only—readings (*a*) being from one head, and readings (*b*) from the other; 14-kilowatt Gibbs shunt-motor:

	Readings.	A.	V.	Elect. H. P.
(a)	Motor only	7.5	241	2.4
	Motor and countershaft	10.0	240	3.2
	Motor, countershaft and idle machine—			
	Downward, 12 ft. per min	17.0	242	5.5
	Reversal	55.0	242	17.8
	Depth of cut, ¾ inch; feed, $\frac{3}{32}$ inch	23.0	248	7.6
(b)	Motor and countershaft	10.0	240	3.2
	Motor, countershaft and idle machine—			
	Downward, 12 ft. per min	15.0	240	4.8
	Reversal	68.0	238	21.6
	Upward, 36 ft. per min	20.0	240	6.4
	Reversal	50.0	240	16.1
	Depth of cut, $\frac{1}{16}$ inch; feed, ¼ inch	36.0	240	11.4

SHAPING MACHINE.

Bement, Miles & Co., makers; one tool head; maximum stroke, 19 inches; planing wrought iron with soda water; 8-inch stroke; 6-kilowatt Gibbs shunt motor:

Speed forward at max. stroke..... 16 ft. per min.
" back " " ..... 32 " "

Readings.	A.	V.	Elect. H. P.
Motor only	4.5	240	1.44
Motor and countershaft	5.0	242	1.6
Motor, countershaft and idle machine	6.0	242	1.8
Depth of cut, ½ inch; feed, $\frac{1}{16}$ inch; stroke, 8 inch	15.0	240	4.8
Depth of cut, ¾ inch; feed, $\frac{1}{8}$ inch, very heavy cut	30.0	242	9.7

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The works of Sir William Armstrong & Co., at Elswick, England, have now in their employ about 19,000 men, and the amount paid annually in wages is about $7,500,000. They have under construction at the present time fourteen ships of war, aggregating 60,250 tons, and 1,300 guns of various calibers up to 12-inch.

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Letters from Practical Men.

Dies and Presses for Needle Eyes.

Editor American Machinist:

Perhaps some of the many die-makers who read this paper, and who have had no experience on the above class of dies, may be interested in the subject and also pleased to get a few points on it. My acquaintance with punches and dies began with those used on needle eyes, and was, I believe, about the first of that method of making them. It was at the beginning of the sewing-machine needle industry, that has since grown to such enormous proportions.

The old method of making the eyes was to first drill them, the diameter of the drill being equal to the width of the eye; from the drill they went to the reamer, who would elongate the eye by a long five-sided broach or reamer, the broach being inserted into the eye, and the needle then swiveled each way very much as a "cub" will do when he is trying to ream out a $\frac{9}{16}$-inch hole with a ½-inch reamer. These reamers were of Swiss make, and were, for the price we had to pay for them, a beautiful piece of work and had a very fine temper. From the reamer the needle went to the polisher who threaded or "strung" it, as we called it, onto a strong linen thread, and by a liberal use of emery, oil and elbow-grease, polished it until it was in shape to use. At the time of which I write, competition was just beginning to make itself felt in the needle business. Manufacturers were not getting $50 per

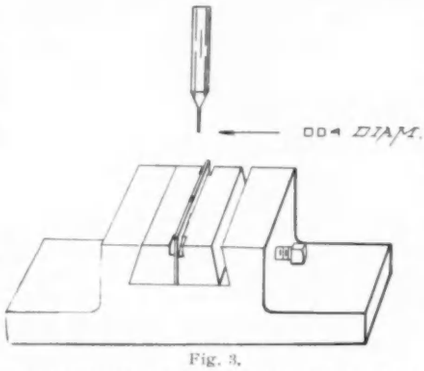


Fig. 3.
PUNCH AND DIE FOR NEEDLE EYES.

Fig. 1.
HAMMER PUNCH PRESS FOR NEEDLES.

Fig. 2.
LEVER PUNCH PRESS FOR NEEDLES.

1,000 for needles as they had been, and were forced to try punching the eyes as a method of reducing the cost.

The first punches and dies that I have any remembrance of for this work were made by Mr. A. B. Holmes, then a noted inventor in that line of mechanics, and the lever press shown in the cut was one of his make. The first experiments were made with what we called the "hammer punch," and which was made on the principle that you can drive a tallow candle through a board—you can do it all right if you only do it quick enough. The punch was driven through the needle by a quick blow of a mallet; this soon gave way to the lever press worked by a treadle, as shown in the second cut. The hammer press shown was discarded many years ago, but the foreman raked up the pieces from under the stairs and put them together for my benefit. Unlike many first inventions, this press was a success from the start, and, in fact, is used to this day in some of the largest shops in the business.

The lever press shown in the second cut is by far the better tool, both as to style and the breaking of punches, but it lacks in speed. A good girl can kick off 12,000 to 15,000 per day on the hammer press, but she is a smart one if she can do 12,000 on the lever style. The dies were made sectional in three pieces, the center piece having a U-shaped place cut out in the center, the width of the U being equal to the length of the eye. This center piece was also as thick as the groove in the needle is wide, and projected up into it, thus supporting it during the operation of punching.

I have made an attempt to show this piece as well as the two side dies in the cut, but the fiend at the camera was more interested in getting a good picture, even if it didn't show what I wanted, than he was in the proper locating of them, and as I have a very obliging disposition I gave in to him. The punches were all made from .080-inch Stubs wire turned down to the proper diameter, and then hardened and flattened off on the sides to give them the proper size for the eye. The smallest punches we made were .004 inch diameter and were used for lace needles; .008 inch and .010 inch were a common size, and I have often seen them punch an eye .015 inch and .020 inch thick, thus upsetting the old idea that you cannot punch over the diameter of your punch.

In the operation of punching, the needle was laid on, or rather in, the die, for the side dies had a groove that kept the blank straight, and then clamped by a lever worked by a foot treadle; then the punch came down, passing through a hole in the clamp and punching the eye, the punch as well as the clamp being worked by a treadle, thus giving the girl both hands to handle the work. In the lever press, the back lever was taken out in moving the press to get a better (?) exposure (another whim on the part of the fiend at the camera), and did not get put into place again.

The pencil sketch shows the design of the die-shoe, and the center and side dies in place.

J. L. LUCAS.

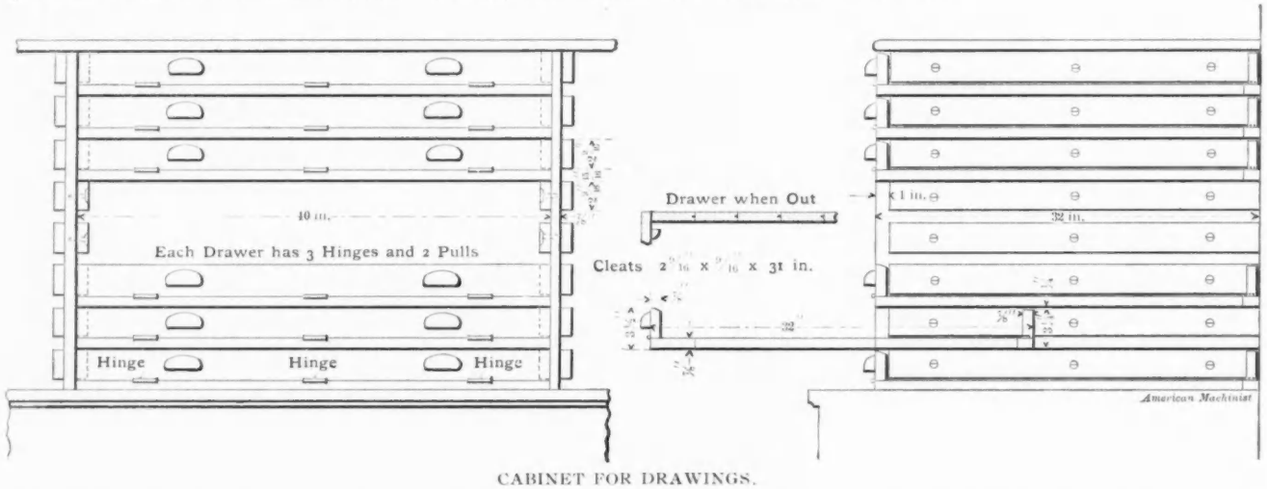
Cabinets for Drawings.

Editor American Machinist:

Regarding cabinets or cases for filing drawings, Professor Sweet's plan, as shown in your issue of September 3d, is certainly an improvement over the old-style drawer. Inclosed I send you a print of case and drawers adopted by Mr. Frederick B. Miles some years ago, and since used with great satisfaction by Bement, Miles & Co. As in Professor Sweet's cabinet, the flooring between the drawers is omitted, and, in addition, the sides have been dispensed with, and the front hinged so as to drop when pulled out as far as desired. The sides of the drawers were found to be entirely unnecessary, and the drop front allows all of the drawers to be readily removed and the drawer easily wiped out when required. The saving in space and in material is considerable in a large system by omitting the sides, and in many years of service no difficulty has been experienced from the drawings or tracings catching or jamming against the sides of the case.

WM. H. DERBYSHIRE.

Philadelphia, Pa.



CABINET FOR DRAWINGS.

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Invention in the Foundry.

Editor American Machinist:

Why are foundrymen so often accused of being lacking in inventive faculties, said to be "opposed to all improvements in the methods practiced in foundries, etc., etc?"

Are they more skeptical than other mechanics? Let us look over some of the important inventions in the last century:

What important improvement in the steam engine ever emanated from steam engineers or firemen? The eccentric, it is said, was invented by a funking or lazy boy. The cotton gin was not invented by a cotten planter, spinner, or weaver. Elias Howe, or Singer, of sewing machine fame, were not tailors. The earliest and majority of latest inventions to economize labor in boot and shoe manufacture were not the inventions of shoe-makers. McCormack did not work at farming when he invented his reaper, and hundreds of other important revolutionizing inventions were the inspiration of others "than those working at the particular vocation most affected thereby."

In the issue of the "American Machinist," September 3d, a writer has the following to say regarding molders: "It is useless to wait for the molder to make these improvements, for but few possess the mechanical ability to design a successful machine, while still fewer have any desire to improve the present old and time-worn methods of making castings."

How often do we hear this kind of statement? and generally by those who are either careless or know but very little about the needs or possibilities of the foundryman. My experience has brought me into very close relations with all kinds of iron and other tradesmen, and I have never seen any greater hunger shown for improvements among machinists, blacksmiths or carpenters than I have among molders. I don't think they are any more apt or fertile in inventions than the foundrymen, nor quite as much so. Of course, there are the ever-present, incredulous and suspicious to be found in the foundry, who fear that the new thing will in some mysterious way work them injury financially. But the same Banquo's ghost is seen by the machinist when some new combination tool is introduced in the machine shop, or power wood planer or a mortising machine is put into a carpenter shop. The thorough skillful molder must be a born inventor; he never will excel in the foundry unless he is full of resources, and has of expedients an abundant store. If in a jobbing foundry, where it is a daily occurrence to get patterns to mold from, of every conceivable shape, form and fashion, with core prints too short or too small; draft cut under; portions fast that should be loose; no rapping or draw plates, covered with some substance with an affinity for sand, usually glue, and extra doses of it in the corners (they are very particular about the last preparation of the pattern, especially if in a hurry), or varnished with something that will not dry in a month, if ever; with draft both ways, so that no matter which side up you mold it you wish you had gone the other way, it would seem as though he must exercise some inventive ability to get along at all.

The above jollities are a few of the vexations a molder is ever beset with. Now add to the above the getting-up of the necessary rigging, flasks, core plates, lift-irons, draw-backs, and have ever in view that cost is an important factor, and that nothing must be made unless it shortens the road either as to time or security from loss. All this is inventing and often of the most cunning kind, and the foundryman takes just pride in circumventing seeming impossibilities from wrong pattern construction. "And of the story will he tell his son (the apprentice) how this and that were done."

The lookers-on can sometimes see the best moves on chess or checker boards, all unseen to those in the game. *Vide* the advice given to Bessemer, who, describing to a friend (not a metallurgist) the difficulty of retaining just the right quantity of carbon in the metal—it sometimes happened right, but more times wrong—the friend advised blowing until it was all eliminated, and then inserting the amount desired. That did the trick.

Shoveling sand, ramming and venting, securing molds, pouring them off often in temperatures dancing from 100 to 125 degrees, is exhausting business. Add to this the never-ceasing nerve tension of anxiety, ever present with the conscientious "jour" or foreman. To the end that nothing has been overlooked or neglected —securing of cores, flask properly clamped, bolted or weighted; iron too hard or too soft, hot enough or too slack—all these and more pass in rapid review when an important piece is to be cast. All these and other conditions have to be right before the supreme moment of pouring; for when the word is given, "let her go," closed is the gate to the correction of any omission. "He would be a phenomenon indeed if, after a daily repetition of these and other cares inseparable from the

foundry management, he had a great storehouseful of inventive inspiration on tap."

The foundryman takes up the strands where others often leave them, in exasperatingly ragged condition, and with his inventive resources brings the answer right. It is this continual sapping of his inventive fount that (to the uninitiated) keeps the stream from overflowering the banks at any particular spot. But I never visited a, to me, new foundry but I saw something worth remembering as an evidence of the foundryman's inventive resources.

L. C. JEWETT.

Boston, Mass.

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Invention in the Foundry.

Editor American Machinist:

I have read with some interest the article on Molding Machines in the "American Machinist" of September 3d, and was somewhat surprised to see Mr. Farwell's statement that few molders, if any, possess the mechanical ability to design a successful molding machine, etc.

I wish to differ with Mr. Farwell on this point. I believe, as a class, there is no mechanic more inventive that the molder. Half of his work in a great many of the shops can only be accomplished successfully by the aid of inventive ability; this ability to be demonstrated without any perceptible cost to the employer. This is especially noticeable where original work is produced, with the probability of but one or two pieces being needed from one pattern, or without any pattern, as the case may be. The molder in such cases is compelled to make a rig which might well be called a molding machine. The real molder (not the "bum") is an artist in his line; he does not want to get up what is generally termed a molding machine, which often has little to recommend it to the trade but the fact that it can be used to turn out an increased amount of inferior work as compared with work made without its aid. I have never seen an instance where a machine of this type ever raised the wages of a molder, or lightened his burden in the least. The general rule is that it gives him a larger sand pile to cut over, and a larger amount of hot iron to pour; or in other words, an increased amount of hard work. The molding trade was once a branch of the fine arts, and I think a molder should study how to produce as fine castings as possible in preference to as great a number as possible.

That there is a need of improvement in the foundry I think every one will agree. The improvement in cranes and ladles has been a grand thing in the foundry, and has helped materially to bring about the end mentioned, namely, finer castings. But what is needed now more than any other one thing, perhaps, is a better system of ventilation, whereby the smoke, steam and gases generated may be quickly carried from the foundry. Many of our foundry foremen would be glad to suggest plans to attain this end; but as this does not plainly show increased returns for the outlay, they know it is useless to ever suggest it.

In conclusion, I wish to state that I believe molders, as a class, are honest to their trade, and that when anything which improves their work is brought forth they will gladly adopt it; but I believe that these improvements will emanate where a great many previous improvements have, i. e., in the foundry.

WILLIAM E. MALPASS.

East Jordan, Mich.

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Tool Room Management.

Some unique ideas prevail in the factory of the National Cash Register Company, at Dayton, O., and among other novel things to be found there is what is called the "Advance Club." This club is made up of foremen, assistant foremen and clerks of the various departments of the factory. The club meets every Friday morning on the company's time and discusses matters of importance to the business. At each of these meetings, in addition to complaints and suggestions from all present, one or two papers on stated subjects are read, setting forth the difficulties met with in actual experience and giving the remedies successfully applied. As a sample of these papers, we give below one read recently by Joseph Kelly, assistant foreman of the tool room. Mr. Kelly said:

"The question of conducting a tool room profitably, from a commercial standpoint, has received considerable attention from many of the leading mechanics of this country for some years past; and while there is some difference of opinion as to details, it is generally agreed that the degree of success attained depends in a great measure upon the application of well-known and recognized principles as applied to the best practice in mechanics.

"Speaking from an experience of over twenty years in tools and tool-making, I maintain that a tool room conducted according to modern methods is as profitable, commercially speaking, as the manufacturing department, which is made profitable to a greater or less extent according to the degree of accuracy attained by the tools that are used in that department.

"Many years ago, when a man wanted to make a tool, he first considered what would be best adapted for that particular purpose. Then he started to make the tool, but, not being satisfied that it would be all right, he went very slow and felt his way along and finally finished it. He then found that it cost just twice the amount that it would had he known what he wanted in the first place. This I would term 'experimental tool-making.'

"The tool room is responsible in a great measure for the profits and losses of the manufacturing departments, as those departments depend upon the design and accuracy of the tools for the quality and quantity of the work produced.

"The tool room in turn depends upon the draughtsman for simplicity of design and absolute accuracy of the drawings. Now right here is where the barrel leaks. To illustrate: A drawing is sent to the tool room, and work is started on a drill jig. There is but one drawing; consequently the work must be given to one man. The drawing is nicely made and the shading very fine, but upon examination it is found that there are no figures to work to. The man now begins to work on the 'experimental plan.' He first goes to the milling machine and works two or three hours, and then has to stop milling for the present. He then drills a hole or two, and then has to get a lathe to fit a pin. He then finds that he cannot get his mill again, for some other man has it, so he concludes to do a little vise-work that might be done to better advantage later on. He goes from one machine to another, making only fair progress, and finally finishes the jig. We look up the cost of this tool and find it to be rather expensive, but having watched the man we can say that he worked pretty faithfully all the time. In a tool room where there are fifty or more men, and where the proportion of men in excess of tools is three to one or more, the time unavoidably consumed in this way is considerable.

"Now, for the means for getting out of this rut. As the tool room provides the manufacturing department with the means of producing work rapidly, accurately and economically, thereby reducing the amount of spoiled work to practically nothing, the company should provide the same protection to the tool room in the shape of a thoroughly equipped and efficient drawing room. The drawings that are supplied to many a tool room at present are merely illustrative, and, instead of giving the required information to the workmen, are often a source of confusion. The value of a drawing depends upon the information it conveys; and if the information is reliable and complete, it is indispensable; if confusing or misleading, it is absolutely worthless. When a tool is ordered, the drawing is the first step taken, and it depends greatly upon the draughtsman whether the cost of the tool will be reasonable or whether it will cost twice what it should.

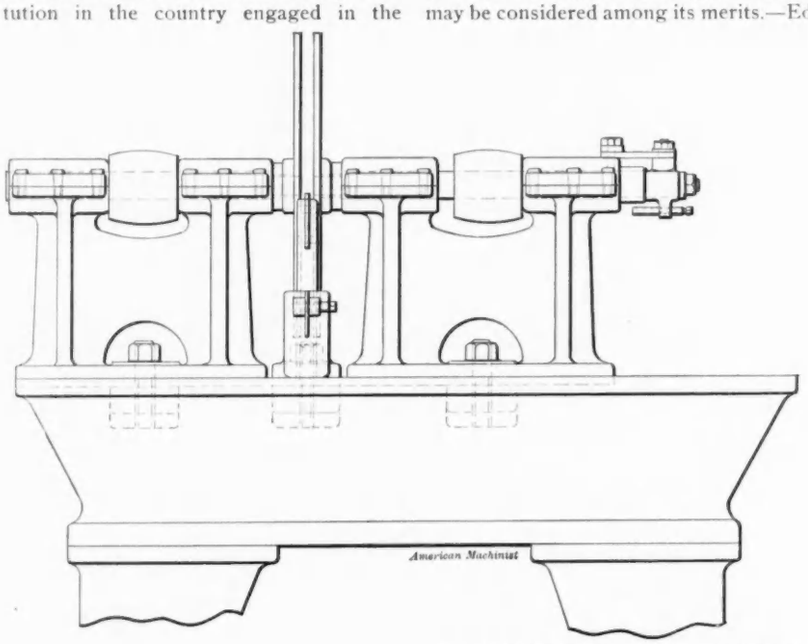
"The essential points to be considered in tool designing are simplicity, accuracy, and, as far as possible, similarity. The drawings and detail sheets when made should be submitted to the chief draughtsman to be passed upon as to their correctness. If found to be correct, they should be 'O. K.'d' by the head of the drawing department. The original sheet is retained in the drawing room, and two or more blueprints (with dimensions and figures accurately and plainly marked) are sent to the tool room. The work is then started on the tool, and instead of having

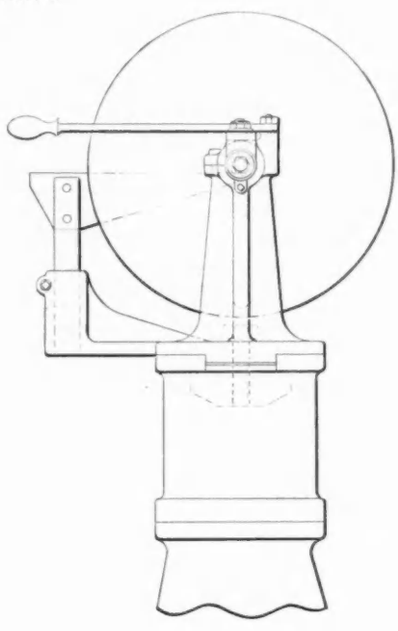
one man working on the 'experimental plan,' we have the means of working as many men on the same job as can be profitably handled. In case of errors in the drawing, any attendant loss or extra expense should be charged to the drawing room, where it properly belongs; and likewise, any errors in machining or in the construction of the tool should be charged to the tool room.

"By this means we will not only increase the efficiency of the tool room, but will make the men more self-reliant and confident; and instead of a company feeling that its tool room is a doubtful investment, it can safely feel that the tool room will be able to hold its own with any institution in the country engaged in the commercial manufacture of tools for a profit."

[Mr. Kelly speaks of difficulties that are familiar in many tool rooms, but are entirely unknown in many others. There is usually no reason why drawings for the tool room should not be figured the same as other machine-shop drawings; but sometimes it happens that dimensions, such as distances center to center of jig bushings, are to be taken from the model and must not be determined by measurement. In such cases the approximate distance should always be given on the drawing for the convenience of the workman, with a note calling attention to the fact that the exact dimensions must be copied from the model, or be otherwise obtained.

All tool rooms where any considerable amount of work is done should, we think, be conducted much upon the same plan as machine shops usually are; i. e., so far as possible, machine tools should be operated by men who "run them" regularly. Much better results are obtained where one man does milling, another grinding, and another lathe work, and so on; the vise men requiring, however, to have a speed lathe or two in common with which to do lapping, polishing, filing, etc., drill-presses, and one or more lathes in which to bore holes for bushings where the work is very close and where responsibility cannot be divided between the man who lays them off and he who bores. In other words, as much as possible of the planing, milling, turning, grinding and other tooling operations on jigs and other fixtures should be performed by men who regularly operate the tools; the extent to which this can be done depending somewhat, of course, upon circumstances. Such a method largely does away with the main difficulty referred to by Mr. Kelly, but it necessitates figured drawings, which fact may be considered among its merits.—Ed.]





DOUBLE-HEAD GARDNER GRINDER.

Double-Head Gardner Grinder.

We have previously referred to the new double-head Gardner grinder, and we are now enabled to present an engraving showing its construction.

The left-hand head is fixed to the bed; the right-hand head can be moved and set at any desired point. Its spindle has about 1-inch movement endwise, this movement being effected by means of a lever which is attached to a sliding sleeve. This sleeve carries a stop screw for adjusting the space between the two wheels. By means of the adjustable stop, many pieces may be ground accurately to size without trying each piece with caliper or gage.

The machine is provided with a rest to support the work when it is being ground. These may be made especially to accommodate work of different shapes, but, ordinarily, a flat surface at right angles with the surface of the wheels, and nearly filling the space between them, is used. For pieces of considerable length as compared with the width, the ends of which are required to be square, a rest is provided with a slide carrying a rib at right angles with the face of the wheels; this is particularly effective for squaring the ends of round, square or flat bars from 3 to 12 inches long.

The operation of the machine is exceedingly simple. The work is placed between the wheels, on the rest, and the movable wheel is brought up to it by the hand lever; this grinds the face next it, and, of course, presses the work equally against the other wheel running in the fixed head. If the work is large enough to allow free use of the hand between the wheels, nothing else is required to hold and move the work on the rest; but if the wheels must be run near together, a stick notched or recessed is used to hold and move the work on the rest between the wheels.

Square or hexagon-head set or cap screws can be simply burred or can be finished very rapidly. The builders have ground the heads of many thousand ⅝-inch and ¾-inch square-head set screws, ready for case-hardening, at the rate of 800 per hour. The machine is equally effective for finishing milled nuts, ready for case-hardening.

Those who have had opportunities of witnessing the astonishing efficiency of these emery-paper-covered dishes as grinding wheels, will readily perceive the value of this machine for work which must have opposite sides finished parallel with each other and to gage. It is made by Charles H. Besly & Co., 10-12 North Canal street, Chicago.

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How to Turn Out Good Molders.*

BY D. F. MATLACK.

I have been asked to give my ideas on the subject "How to Turn Out Good Molders."

*Read at the Philadelphia meeting of the American Foundrymen's Association.

I cannot say that I have ever favored or practiced any fixed system which had this object in view, excepting to encourage good boys who showed intelligence, and were hardworking and painstaking. My actual experience has been confined to one foundry in which I have been sucesssively, apprentice, journeyman and foreman, and any observations noted herein are produced from many years' participation in the business in those capacities. The foundry in which I have acquired my experience has, during all these years, been able to command a class of business of great variety and high character of requirements, and therefore apprentices and journeymen have had exceptional opportunities for advancement and improvement.

The art of molding is very ancient and many men have been engaged at it, all the good ones recognizing the fact that there was room for improvement, and that they individually could always learn something more about it. The best way to turn out good molders, I should think, would be to encourage the good, the intelligent and the industrious boys, and, after a fair trial, dismiss the incompetent and idle ones. Those of the latter class should seek fields where hard work and intelligence are not so largely required and seriously needed. Boys who are not fitted for the trade, but who are anxious to get along, should be advised and helped to secure a trade of a different character and more in keeping with their peculiar fitness. Boys who are not anxious to get along, should be dismissed, for the reason that the molding art requires, for successful attainment, the reverse characteristics. When a boy is not adapted to the trade for various reasons; when he is natually incompetent, idle or vicious; or when he is not so inclined, but is kept at it by parents or guardians, and perhaps, if he had the chance, would adopt another calling, he should not be encouraged to continue an apprenticeship which could not result in any benefit to either himself or his employer. It is not always easy to make up one's mind to discharge boys who do not fit the business, and I will admit that I have not always practiced what I am preaching. But I am convinced that in all such cases I have erred by reason of mistaken kindness or unwillingness to possibly harm the boy, or disappoint his relations or friends, for whom I had a kindly and a closer feeling.

For the good of the trade and the business, as well as for the ultimate benefit to the boy, I believe that fitness, industry and intelligence only should be rigorously recognized. Intelligence and education are always great helps to boys in this as in any other calling, although our most intelligent and better educated boys generally develop into employers of some description. I have noticed that those apprentices who have developed into first-class molders have been successful mainly by reason of their own efforts, application and natural ability. It has been the rule in our shops that a boy should have the opportunity to so advance, and the same fact I suppose holds good in any other shop or trade. The best and most intelligent boys generally develop into something better than good molders. Some become foreman, and there are still others who engage successfully in business of a different character. Sometimes they stick to the trade, but, as a rule, brains and education will not be confined to simply becoming a good molder.

I have always believed in affording opportunities to apprentices who have evinced a disposition to take advantage of them. Any of our apprentices who are careful, painstaking, hardworking and who also possess adaptation and inclination for the business cannot help finding the way, means and opportunities necessary to make them good molders. If they remain with us after reaching their majority, the improvement is sure to go on for the reason that our business has always covered such a large variety of the highest character of castings. This must have been so, as shown by our men being in demand all over the United States, not only as journeymen, but also as foremen, and quite a number have engaged in business for themselves.

It is the rule with some establishments, including our own, that a portion of the wages of the apprentice shall be withheld and given to him in a lump sum at the expiration of his apprenticeship. This practice may be advantageous to both the boy and his employer in some ways, and I will not record myself as definitely either opposed to or in favor of the practice. I will only say that I cannot see that it operates to the advantage of the object to be gained—"turning out good molders;" for while it may have some slight effect in holding the good boy to the trade, it would also operate against the inclination of the employer to get rid of the incompetent boy, thus saving to himself the accumulated wages of which the boy will be deprived.

Any rule, practice or system inaugurated with a view of improving the grade of molders will to a large extent fail if the principles I have tried to explain are not given due consideration. Good apprentices will make good molders, and the larger the variety and the higher the quality of opportunities given them, the better will be the results as to the ability of the molder turned out.

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Magnesium.

Some increased attention is being given of late to the properties of magnesium as a metal. Contrary to the popular impression, it is considerably lighter than aluminum, a cubic foot of it weighing only 109 pounds, while a cubic foot of aluminum weighs 166.5 pounds, and a cubic foot of iridium would weigh 1,396 pounds. Magnesium melts at 811 degrees Fahr. and its electrical conductivity is 41.2 per cent. that of copper. The tensile strength of the metal ranges from 22,000 to 32,000 pounds, its elastic limit in wire is about 8,770 pounds, and modulus of elasticity 1,945,000 pounds, or less even than that of many stones. The tensile strength of the cast metal is less than one-half of that given above. Magnesium used as an alloy of aluminum up to 10 per cent. increases its tensile strength and modulus of elasticity, but larger proportions render it weak and brittle. No success has followed various attempts to produce alloys of copper and magnesium.

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Contracts for Three New Battleships.

Contracts for building three new battleships for the United States Navy were awarded on September 14th. Five bids were offered; the bids were remarkably close, and were considered low. The successful competitors were: The Newport News Shipbuilding and Dry Dock Company, Newport News, Va., one battleship for $2,595,000; William Cramp & Sons' Ship and Engine Company, Philadelphia, one battleship for $2,650,000; and The Union Iron Works, San Francisco, one battleship for $2,674,000. As an allowance of 4 per cent. is made to Pacific Coast builders to cover extra cost of transportation, the bid of the Union Iron Works was practically very close to that of the Newport News Co., and considerably below that of the Cramps.

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Gas Exposition.

For two weeks, beginning January 25, 1897, a Gas Exposition will be held at Madison Square Garden, New York.

The proposed exposition is the first affair of the kind attempted in this country. In a number of European countries, gas exhibitions are a regular feature of each year's entertainments. At the present Berlin exhibition the gas building is said to be one of the most pleasing, and at the same time a very interesting exhibit.

The New York affair will be managed by a board of directors, assisted by an executive committee, both composed of well-known men interested in the production and use of gas. Gas engines and other machinery will be included in the exhibit. E. C. Brown is the managing director, and his office will be, for the present, at 280 Broadway, N. Y.

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At the annual meeting of the stockholders of the Westinghouse Air-Brake Company, the president, Mr. George Westinghouse, stated that the business for the past year had been the most prosperous in the history of the company. The gross business was $5,947,600.57, and the profits were $2,607,936.44. The old officers and directors were re-elected.

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Edward P. Buffet,
} Associate Editors.

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Space in advertising pages only is for sale.

We invite correspondence on subjects pertaining to machinery.

Name and address must always be given, though not necessarily published.

Communications for or relating to the reading columns should be addressed to the Editor. All business communications should be addressed to the Company.

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Variable Speeds for Machine Tools.

We know well enough the necessity of cheap production if we are to successfully compete with other cheap producers. In the problem of cheap production in the machine shop, the speed of the cutting tool is one of the most important factors. Many investigations and elaborate tests have been made, and voluminous records are accessible bearing upon this point. The lesson has been formulated, but to this day comparatively few have learned the essence of it. While we are talking about cutting speeds we are not providing the means for securing the speeds that are shown to be desirable.

Is it not absurd that, in the light of actual knowledge, nine-tenths of all the iron planers in the land to this day are run at one constant speed all the year round, and no matter what may be the material worked on? Light cuts or heavy cuts, on tool steel, cast iron or brass, the planer wags along at the same measured pace, the pace being set always at the slowest that is ever required.

The planer is only one instance, and perhaps not the worst. There are so many cases in the machine shop where variable speeds would immediately tell on the output. On lathe work how many cases occur where the cut changes from one diameter to another, either gradually, as in facing flat surfaces, turning conical shapes, or in cutting off material, or all at once, as in cases where there are steps of different diameters, or where a heavy cut is succeeded by a light one, or *vice versa*. Cone pulleys, with the constant necessity of shifting the belt from one step to another, meet the requirements of the case in the crudest possible way, and, indeed, do not half meet it at the best. A change from any given speed to another speed seventy-five per cent. or a hundred per cent. greater or less is far enough from satisfying a demand for speeds ranging anywhere between these adjacent cone speeds. Workmen, too, are exceptionally enterprising who will shift the belts on cone pulleys every time it becomes possible to use the next one.

There is scarcely a tool in the shop, from grindstone or emery wheel as they wear away, to the big boring mill or the planer, where a minutely and instantly variable speed would not pay for itself many times over. At the same time we must confess that it would not be an easy matter to make many shop proprietors believe it, and attest their belief by their practice. If a lathe or a planer were put on the market with a good variable drive such as is required, and which would probably increase the output of the tool twenty-five or fifty per cent., the maker would be thought to exhibit great assurance if he should add one per cent. to the price of the tool. It is well, however, to keep talking about these things, and, by the way, the variable speed countershaft in our present issue is worth looking at in this connection.

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Position of the "American Machinist" on Politics.

It seems to be quite the fashion for trade and technical papers to go into politics just now, and a good many of them seem to think it part of their mission to instruct their readers on the immediate duties of American citizenship. Some have wondered why the "American Machinist" has not declared its position, and we now propose to make such a declaration.

Our position is, briefly, this: The "American Machinist" is a technical journal. Our readers subscribe and pay for it because they wish to know as much as possible about the science and practice of machine construction, and what is going on within machinery interests. They are intelligent men, capable of forming their own opinions, and we believe every one of them, except those on our foreign subscription list, is a genuine patriotic American citizen, who, if he does not understand public questions as well as he would like to, can find plenty of literature bearing on those questions—literature prepared by men who are better equipped for the work than we can be, in the nature of things.

All the editors whose ideas find expression in these pages have their opinions on the questions now under discussion. At proper times and in proper places they do not hesitate to express these opinions, as is the right and, indeed, the duty of an American citizen. But we do not consider the pages of a technical journal such as ours the proper place for such expressions of opinion, and shall not presume that our readers need instruction on public questions which they cannot better obtain from other sources.

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Power for Driving Machine Tools.

Elsewhere in this issue will be found another collection of data regarding the power required for driving machinery by means of electric motors, previous installments of which have appeared in our columns from time to time during the past six months.

We have now given a fairly complete collection of tests covering the more important large iron-working machines. It is not too much to say that the articles which have already appeared in our columns give more information on this subject than is in existence elsewhere. The value of the data is sufficiently shown by the fact that the articles have been extensively republished entire, both in this country and in Europe—sometimes, we are sorry to say, without credit.

The present article is in some respects the best that has so far appeared, as it gives more exact figures and a greater range of feeds than any that have preceded it. It covers in a general way the same class of work as the article which appeared February 6th, and serves to confirm the figures there given as to the heavy consumption of power by tools when taking heavy cuts.

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Our English contemporary, "Machinery," comments upon the fact that the Chicago house of Fraser & Chalmers is not at present making much if any money, while their English branch is making money, and takes occasion to indulge in what an Englishman would call "American brag and bounce" if the same things were said in this country. It charges that the facts as stated above are due to the superiority of British methods and machinery, which is decidedly amusing, and leaves out of account the seemingly important fact that machinery interests in this country have for two or three years past been having very hard times of it, while in England times have been decidedly better during the same period. This would seem to be sufficient to account for the facts referred to; but instead of accounting for it in this way, we are given an elegant example of bragging, which some would have us believe is indulged in nowhere else but here, and by no one else but "Yankees."

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Our readers, of course, understand that we very frequently publish statements of fact or of opinion with which we ourselves

are not in agreement. We desire to have it understood that the "American Machinist" is not so much a medium for the expression of its editors' views and ideas as it is a forum in which those who construct machinery and are interested in it can be heard on subjects pertaining to machinery, to the extent that is consistent with the character and purpose of the paper. In this issue two foundrymen take issue with what was said by a previous correspondent regarding the inventiveness of members of their craft. We expected such criticism of his views, and shall now expect that the views of Mr. Malpass regarding molding machines will find critics. We ourselves do not agree with him on this subject, but, nevertheless, Mr. Malpass is a foundryman, and evidently a successful one—part owner of a foundry, in fact. As such he is entitled to hold and to express his opinion regarding foundry affairs, and in the end the right view of these matters will probably prevail.

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Questions and Answers.

Name and address of writer must accompany every question. Questions must pertain to our specialties and be of general interest. We cannot undertake to answer questions by mail.

(168) G. T. C., Quncy, Ill., asks: How high is it practicable to lift water with a centrifugal pump? A.—We would say 40 feet, not that that is the limit, but that the efficiency falls off rapidly above that. In California, centrifugal pumps are successfully worked against a head of 100 feet. L. Dumont, Paris, shows four centrifugal pumps taking water from one to the other successively, all driven by one electric motor and raising water 40 to 60 meters, or, say, 130 to 195 feet, and by this "tandem" arrangement high lifts are attained with fairly good efficiency.

(169) J. L., St. Louis, Mo., asks: 1. What pressure will be safe for a horizontal boiler of the following dimensions: 48 inches diameter, 20 feet long, shell $\frac{5}{16}$ inch thick, heads $\frac{7}{16}$ inch thick, with twelve 6-inch flues, double-riveted? A.—For a boiler of this style the strength of the shell will determine the strength of the boiler, and no attention need be given to the flues, assuming that they are securely fastened to the head and that sufficient stays are provided for the flat surfaces of the heads above the flues. The question seems to say that the flues are double-riveted, but does not say that the shell is. The Supervising Inspectors of Steam Boilers give the following rule: Multiply $\frac{1}{6}$ of the lowest tensile strength stamped on any plate of the cylindrical shell by the thickness in inches of the thinnest plate and divide the product by the radius of the shell in inches; the result will be the pressure allowable per square inch for single riveting, to which add 20 per cent. for double riveting. In the case before us we are not told the tensile strength of the sheets, or even whether they are steel or iron. Assuming the tensile strength to be 50,000 pounds, we have: $50{,}000 \times \frac{1}{6} \times \frac{5}{16} \div 24 = 108$ pounds. This result is for single riveting; then for double riveting it would be $108 + 21 = 129$ pounds. For any other tensile strength the result would be directly proportional. 2. How can I obtain the United States Government inspection rules for the inspection of boilers? A.—Apply to the local United States Inspector of Steam Boilers; you will find one in St. Louis.

(170) "Cams" writes us asking a number of questions about cams. His greatest trouble seems to be about the noise. He asks: 1. Will a cam run with less noise when the radius of the roller path is increased? For instance, a cam roller bearing a given load is to move radially 1 inch while the cam turns 45 degrees, running at 100 revolutions per minute. The radii in this case are 8 inches and 9 inches respectively. Finding that said cam makes too much noise, would the noise be lessened if the radii of the cam were increased to 16 inches and 17 inches, the radial movement of the roller to the given angle of revolution being as before? A.—The work of the cam at present would not seem to be excessive, but the proposed increase of radius would, of course, reduce the driving angle and should reduce the noise. The roller should at all points fill the cam groove as closely as possible, so that backlash would be avoided, and the curve of the cam should distribute the movement as equitably as possible over the entire available portion of the revolution. In this connection an article by Mr. C. L. Redfield, on page 562 of our issue of July 18, 1895, will be found interesting and instructive. 2. In a cam with the same particulars as above, suppose that by change of leverage we reduced the required movement of the roller to ½ inch instead of 1 inch. Would that reduce the noise? A.—It would, of course, do so, other things being equal; but as the pressure on the cam face would be doubled, it would all depend upon whether that was excessive or not, and that we know nothing about. 3. Supposing the angle of roller movement, radial advance and revolutions of cam to be fixed, what is the best shape for the path of roller to reduce the noise to a minimum? A.—This precise point is treated in Mr. Redfield's article, referred to above, quite clearly and more fully than we have space for here. 4. Will a cam roller move without gripping in a curve of same radius as roller? A.—Such cams are used in some cases. The "gripping" will, of course, depend upon the depth to which the roller will drop into the coincident path. The reversal of movement of the roller must be theoretically instantaneous. The instant that it drops to the bottom of the curve it must begin to lift out again, so that the cam curve could not possibly coincide with the roller except for a very small angle. A cut is shown in some of the books where the roller fits the cam curve for 90 degrees, but it would seem that it could only be possible for the roller to touch bottom when the cam was turning very slowly. 5. What book can you recommend as containing the most definite and practical instruction relating to the above questions? A.—Goodeve's "Elements of Mechanism" is probably as good as any that we know. 6. Relating to machinery in general, what is the ratio of increase of power required when speed is increased, say, double. For instance, suppose a planing machine with revolving cutter head is cutting a chip ¼ inch deep from boards 12 inches wide, with cutter head running 1,500 revolutions per minute; now, if it be required to run the cutter head 3,000 revolutions, how much more power will be required? A.—We understand this question to have nothing to do with the act of acceleration up to the required increased speed, but to the maintenance of the increased speed after it is attained. If the resistance is constant, the power required will be directly as the velocity, so that, within reasonable limits, double the velocity will require double the power; but the cases are few where the resistance can remain constant. In the case of the cutter head referred to, with the same chip and the same feed ratio, double the speed should require double the power, only that the removal of the chip would require more force at every instant than before. Material when being cut requires time to yield, and the same cut requires, on that account, more force at the higher speed. The friction of the air at the higher speed also increases the moment of resistance of the cutter head and belts. 7. Can you give a general formula covering the laws involved in question 6? A.—We certainly cannot.

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Business Specials.

Transient Advertisements 40 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Gear wheels, gear cutting. Grant; see page 12.

Forming Lathes. Mer. Mach. Tool Co., Meriden, C.

Milling Machs. Kempsmith Co., Milwaukee, Wis.

Engine Castings 1½ to 2 H. P. Finished boilers and engines. Grant Sipp, Paterson, N. J.

Presses and dies for bar and sheet metal work. Ferracute Machine Company, Bridgeton, N. J.

George H. Stagen, Machine and Patent Office Drawings. Room 111, No. 115 B'way, N. Y. City.

Just Issued—Catalog No. 8. Mailed free. Clayton Air Compressor Works, 28 Cortlandt st., New York.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N. Y.

Duplex and special gear cutters, counterbores, cutter and surface grinders, vertical millers, hand punches and shears. R. M. Clough, New Haven, Ct.

Patent Soliciting of High Class.—D. Walter Brown, Counsel in Patent Cases, 111 Broadway, New York. Send for "Brief History of Patent Legislation."

For Sale or Rent—Foundry and Machine Shop with additional land; in good condition and well equipped for medium heavy work. Capacity of foundry, seven tons per day. Located on railroad within eight miles of New York. Terms easy. Call or address, Room 41, 22 William st., N. Y.

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Figuring and Guessing.

"A writer in a contemporary gives a rule for the area of steam ports, which shows the absurdity of trying to make one formula fit all sizes of steam engines. After giving the rule he works it out and finds that the port for a 2-inch cylinder should be 1.5 long by $\frac{3}{32}$ wide. This dimension is, as most mechanics know, about the thickness of the back of an ordinary table knife. The inadequacy of it for its purpose leads the discoverer of the rule to discard it and say: 'In practice the width of a port is seldom less than ⅛ inch, so we can make the port ⅛ inch wide and 1.5 long.' If we have to guess at the end of the rule, we don't see why we may not guess before making figures!"

The above we take from Mr. Watson's "Engineer." It evidently refers to Mr. Meyer's article entitled "Dimensions of Small Marine Engines and Boilers," published in our issue of September 3d, and for an answer to his question, and also for those others, if any there be, who cannot see why the results given by a rule cannot sometimes be modified without impugning the integrity of the rule, we cannot perhaps do better than to refer to Prof. De Volsen Wood's articles in our issues of June 6th and 20th (pages 483, 449), 1895.

In these articles the learned professor

takes special pains to make this matter plain to even the simplest understanding, and illustrates the matter by taking the case of a computation for the thickness of a cylinder. We all know, at least most of us do, that it is hardly safe to decide the thickness of a cylinder by guessing at it, and as most of us cannot pretend to know just how thick cylinders of different diameters, and to stand different pressures, should be, we usually apply the rule or formula for those cases which go outside our personal knowledge. Professor Wood explains with painstaking detail just why the thickness of a cylinder should be first computed; using as factors in the computation the diameter, pressure and strength of the material. This will sometimes, especially with large cylinders and high pressures, give the proper thickness without allowance; but where, as is apt to be the case with low pressures or very small cylinders, the rule gives a thickness too little when considered from the molder's or the machinist's standpoint, it must be made thicker, and judgment and experience must determine how much thicker. If it is asked why a formula is not made to fit all cases, then the reply is simple: Such a formula cannot be made.

It is the same way with steam ports. Experience has taught us just how fast we can drive steam through a port to advantage. We know that when we attempt to go beyond this speed, there is too great loss from friction and wire-drawing. It is well, therefore, for those who do not know intuitively, or by long experience, all about engines, to figure the size of ports so as to be sure they are large enough—and for any but the smallest engines the rule applies without modification; but when the result of the computation for a small engine gives a port so small as to be impracticable for the molder, or for any other reason inadvisable, it should be made larger, and the only drawback to doing so is that it increases the clearance beyond what would be necessary from a consideration of wire-drawing alone; and the clearance is not usually seriously objected to on a small engine, though it would be on a larger one.

This, it seems to us, is a satisfactory reason for using a rule, and not guessing all the way through. If there is a better way than this we, and in fact engineers generally, would be delighted to hear of it. It is conceivable, perhaps, that a man might learn and memorize the sizes of ports for all conditions of diameter and length of cylinder, steam pressures and piston speeds, but most of us cannot hope to do this, and a table of sizes for all varying conditions would be rather awkward and often inaccessible. Rules or formulæ for such things are therefore used, modified as occasion may require, and this will probably continue to be the practice until someone shows us a better way.

Compressed Air at the Tennessee Centennial Exposition.

The following letter from Prof. W. T. Magruder, Chief of Machinery of the Nashville Exposition, was addressed to the editor of the "Railroad Gazette." Its circulation should help to promote what Professor Magruder has worked for so assiduously—the success, especially of the machinery feature, of the exposition:

"The idea of a Compressed-Air Exposition was suggested to the writer by an article in the magazine "Compressed Air," published by the Ingersoll-Sergeant Company, of 26 Liberty street, New York.

"While the writer has mapped out several lines of compressed-air machinery, and has secured several exhibits, he regrets that his removal to Columbus, O., will prevent his carrying his ideas through, but trusts that they will meet with cordial support by his successor. The number of industries which are now finding that compressed air is a faithful and efficient source of power is increasing very rapidly, over 250 being now on the list.

"Going around among shops this summer, the writer was surprised to see how general the use of chipping machines, driven by compressed air, had become in foundry, machine and boiler shops, to say nothing of the stone yards, and the testimony of the men who use the machines convinces me that some of the makes have come to stay.

"The writer is also of the opinion that compressed-air refrigerating can be successfully and economically applied to the cooling and ventilation of buildings during our intensely hot weather, and that the day is not far distant when men of means will no more think of sitting in their offices with the mercury registering 90 degrees to 100 degrees Fahr. without refrigerating machinery than they would think of sitting in the same office in winter time with the thermometer from 10 degrees to 40 degrees Fahr. without heating machinery. This belief may be heresy and the ideas may be a 'little previous.' I have talked it over myself with a number of experts, and we have come to the conclusion that it is more a question of finance than it is of engineering.

"We are hoping to have a compressed-air intramural railroad around the exposition grounds.

"W. T. MAGRUDER,
"Chief of Machinery."

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Old and New Methods in Boiler Making.

The following paper, which our readers will thank us for reproducing, was read at the Cleveland meeting of the American Boiler Manufacturers' Association, by Henry J. Hartley, superintendent of the boiler department of the Wm. Cramp & Sons Ship and Engine Building Company, Philadelphia:

There has been such a radical change in the conditions of engineering, and such advances in the construction of the boilers made necessary to meet these conditions, within the last thirty years, that the art of boiler making can be grouped in two classes, ancient and modern. Since the American Boiler Manufacturers' Association was organized for improving both the construction and workmanship of steam boilers, it will not be amiss to take a glance backward to the earlier days of boiler making. It will not require a very great stretch of the imagination on the part of many of the members of the association to carry them back to the diminutive and poorly equipped boiler shops of thirty years ago, and to note in their minds the methods used in constructing the boilers of that period.

First we are confronted with a poorly constructed building for a shop, often and truly termed a boiler shed, low, dark and dirty; with hardly enough head room to permit of the erecting of a boiler exceeding 10 feet in height; with floor of mother earth, often convenient for digging pits for the accommodation of work when too large for the height of the shop; with an absence of light and ventilation sufficient to suggest the blackness of the historical black hole of Calcutta, making oil lamps with their meager light a necessity at all hours. So much for the building; next the poor facilities with which the so-called shop was equipped, often without motive power, and entirely without lifting or hoisting facilities other than a set of blocks and an old rope triced to an overhead beam. The flanging fires were constructed so that it was difficult to make a heat exceeding 12 inches in length. The art of annealing and straightening flanges by first heating them in a furnace was unknown. Consequently, they were often left far from being true and straight. The work of remedying this was left for the fitter. He did it with pulling bolts, etc., as the work was fitted together, or, still worse, straightened the flanges while in a cold state by pening them with a sledge, leaving all evil consequences to be developed later on or after the boiler was put in use. The punching of the rivet holes in the plates depended for exactness largely on the correctness of the eye of the operator of the punch. His only guide was spots of white lead to indicate about where the holes were to be punched. They were often twice as large as the hole required. The size of the rivets and the spacing thereof was not, as a rule, taken into consideration as a factor in determining the strength of the seams, each shop having its own practice, all materially differing. Some of the makers contended that the greater the number of rivets the stronger the seam. They even doubled the rows of rivets for that purpose, thereby unknowingly obtaining a less percentage of strength than could have been secured in a single-riveted seam. Others did the spacing to suit the most convenient sub-

division of the marks on the two-foot rule. The chemical qualities of the boiler plates to be used were never specified, nor the physical condition always taken into consideration further than that it should be of "best flange iron or steel."

The punching of the rivet holes having been completed, and the plates having been bent to the required circle or shape, the operation of fitting up and truing the rivet holes, with the half-round reamer and baneful drift pin, commenced. After that the holes were considered good if the rivets would enter them, even at an angle of from 60 to 80 degrees to the plane, and notwithstanding their oblong shape.

The riveting being completed, either by hand or the old belt-driven power riveter, the delicate and particular operation of chipping and calking, often splitting, was gone through with. When this was done by unskilled and careless workmen it often led to damaging results. After the tubes had been fastened in place, and after the heads were pulled from a bulging shape to a flat by means of bolts, chains and turnbuckles, the boiler, already on a strain, assumed a shape and condition ready to be subjected to a still further strain, that of the hydrostatic test. At this stage, in the absence of any arbitrary laws governing the steam pressure that boilers could safely work under, this conversation between the owner and the builder usually occurred: Builder—"Mr. Owner, what pressure do you want to carry on this boiler?" "Oh, I don't know; about 60 pounds, I guess. I might want to carry 100 some day." "All right," says the maker; "boys, put on 100 pounds." If the boiler was of internally-fired or furnace type, generally a waterproof suit was appreciated as an adjunct of the wardrobes of the men making the test, and if of the cylindrical type the umbrella was a useful article of protection to those in close proximity against a wetting.

Finally the boiler was finished and painted, either black or red. The builder felt proud of his handiwork, conscientiously believing that he had turned out of his shop a good honest job. The innocent owner or purchaser, and often the victim, was satisfied that he had the best and safest boiler in his section, poor fellow! If epitaphs stating the cause of demise of the departed were still engraved on their tombs, as of old, I have not the least doubt but that the leisurely stroller, in passing through our cemeteries, would be confronted with tablets on which were engraved lines reminding the reader that a boiler explosion had sent there the long sleeper beneath, and probably reading similar to the following:

> Here lies the body of John Smith, a miller,
> Who got a steam boiler from Killer;
> The boiler blew up and put out Smith's fire,
> Thus ending the life of the miller.

Now the most of this ancient and old style work has passed out of existence, and what remains of it, under the present practice of modern engineering, must be short-lived. What do we see instead of the old system referred to? First, a large, roomy building especially constructed for shops, equipped with all the modern appliances for handling and making the largest and heaviest of steam boilers known to modern times, such as electric and other power traveling cranes capable of lifting and carrying a marine boiler of 100 tons weight; flanging and riveting machines with small tool cranes, all worked by hydraulic pressure from a central power accumulator; radial drilling machines capable of drilling every hole in a shell or tube plate without shifting the plate after once being laid on the table; electric traveling boring mills with a horizontal sweep of 16 feet and a vertical adjustment of 13 feet, sufficient motion in each direction to drill or tap all holes required in a boiler 15 feet in diameter or 16 feet long without moving after one setting; plate planers with the traveling heads moving at right angles to each other, so that the end and side of a plate can be planed at the same time; vertical bending rolls capable of bending the largest plate made and of $\frac{9}{16}$-inch thickness, with numerous smaller tools and appliances to suit special work that the shop is accustomed to doing. Thus, with such shops and their facilities as described, the work of making boilers becomes as easy and is attended with no more difficulties to-day than thirty years ago, notwithstanding the radical changes and evolutions in this branch of industry during that time.

For the information of the members of the association, I will endeavor to give a description of the construction of modern marine boilers of Scotch type for the transatlantic, coastwise and United States Government service, as having come under my supervision at the shipyard of Wm. Cramp & Sons, Philadelphia. First of all, in designing marine boilers, especially for transatlantic service, the insurance laws and rules of the several nations are generally taken into consideration, in order that the vessel for which they are intended may derive all the commercial advantages accruing therefrom, such as insurance, registry rating, etc. If the vessels for which the boilers are intended are to ply between the United States and British ports, they are usually built under the rules of the English Lloyds and Board of Trade, and if to the ports of France and Belgium, under rules of the French Bureau of Veritas. In either case the law of the United States Treasury Department governing steam vessels must be observed. Now, as these several rules and laws differ in their specifications for boiler materials, it becomes necessary to manipulate and modify them to a form of specification that will be acceptable to each. This being done, and the materials obtained from the mill, after first being inspected as to required sizes, chemical and physical qualities, etc., by the mill inspector, the materials are then subjected to another inspection at the shop before any work is done on them. If the boilers are for the United States Government service, the plates are first cleaned of all mill scale by being immersed in a bath of muriatic acid diluted with water. This process exposes all defects, such as pits, snakes and seams, previously not visible.

After passing inspection, the plates are then laid out or marked off in the order in which they are first wanted for the job—the flanging of the heads first, if possible; then the other parts. All this is done by machine, except the small corners, after which they are all carefully straightened and annealed in a special closed furnace. The shell plates have tack holes drilled in them before being rolled or bent to the required circle or shape, after which all rivet holes are drilled through the solid, and all the edges of the plates, either where calking is required or not, are planed before being bent. The front heads of boilers exceeding a diameter of 12 feet are usually composed of three plates each, the lower plate containing the furnaces, the middle plate the tube holes, and the upper plate, which is of increased thickness, the stay rods. After these plates have been flanged and fitted together and fitted in the shell, the whole is placed on a turntable on end, and a gang of four power drills is put to work, and continued until all rivet holes are drilled. Next the whole shell is taken apart, and all burrs, scale and dirt removed, and the faying surfaces or laps are all rubbed off and washed clean with a solution of lye, so that a perfect fit may be obtained. This rule is adhered to throughout the building of the boiler wherever two surfaces come together, including the tubes. All manhole surfaces and other fittings are tool-faced at their bearings, so that tight joints may be assured. All rivets in the shell, excepting those in the front head, are hydraulic driven under a pressure of 135 tons on the ram or piston. The pressure is regulated to suit the size of the rivet by the Wood reducing valve, attached to the cylinder of the riveter. The holes for the hand-driven rivets are all countersunk to the depth of about one-third of the thickness of the plate, since it has been found by practice that the countersinking is a preventive against the heads of the steel rivets flying off under the blows of the riveting mauls.

After the boilers are completed and the mountings are all attached, the hydrostatic test is applied. If built under the United States laws a pressure of 50 per cent. above the working pressure of steam is required, but if built to work under the rulings of the Lloyds or the Bureau of Veritas, a pressure of 100 per cent. exceeding the working pressure is necessary. Thus, if the boiler is to work under a steam pressure of 200 pounds per square inch, a hydrostatic pressure of 400 pounds must be applied. This enormous and at

first appalling pressure was applied to the boilers on the American line steamers of the International Navigation Company, "St. Louis" and "St. Paul," and I must confess that it was done with misgivings on my part as to the result; but the fact was soon demonstrated that it is as practicable to make boilers strong enough and to make them as perfectly tight under high pressure as it is for low pressure.

The boilers referred to in the "St. Paul" are of the double-ended Scotch type, 15 feet 7½ inches diameter, 20 feet long. The shells are made of $1\frac{9}{16}$ inches thick carbon steel, each boiler containing eight corrugated furnaces 3 feet 7 inches diameter, 7 feet long, and 4,992 2¾-inch tubes, 7 feet long, of which 3,024 are extra heavy stay tubes screwed into the tube sheets. The shells of the boilers are riveted with 1½-inch rivets of mild steel, and calked with the round-nose calking tool, sledge impact. The weight of each boiler, exclusive of smokeboxes and fittings, is 206,500 pounds = $92\frac{1}{8}$ tons. and the weight of water under steam 112,600 pounds = 50 tons, the total weight of the boilers in the ship being 1,699,600 pounds = 758¾ tons, with a weight of water 907,600 pounds = 405¾ tons, making a total weight of boilers, including water, 2,607,200 pounds = 1,164½ tons. The boilers in the "St. Paul" have the Serve ribbed tube instead of plain tubes. The total grate area in each ship is 1,144 square feet, consuming 13 tons of coal per hour, or 25.47 pounds per hour per square foot of grate surface.

The boilers in both ships named are fitted with the forced-draft hot-air system, consisting of a series of heating tubes placed vertically in the tops of the coal-boxes immediately above the tubes in the boilers, the hot gases passing through them on the way to the smokestack. At the same time a current of cold air is forced, by blowers, into the heating chambers, which, after being heated to a temperature of from 350 to 400 degrees, passes down the distributing hot-air ducts to the furnaces below, entering beneath the grates, the volume being regulated with damper valves so as to secure the most perfect combustion possible. Care must be taken to make the casings and uptakes airtight, or the arrangement is not so effective, as the gases escape into the stokehole, making it both hot and dusty, and consequently very uncomfortable for the firemen.

In connection with this subject, I will here state that there is in use another system of artificial draft, termed the induced draft system, which is the reverse of the forced draft referred to, since exhaust fans are placed in the tops of the uptakes, sucking the heated air through the boilers instead of blowing it through, as in the first case. The mechanical arrangement as to principle is similar in both systems. The latter, however, makes the more comfortable stokehole, as the dust and hot air are drawn therefrom through leaks in the casings and when opening the doors for firing. It also possesses another advantage, that of exhausting the hot air from the space over the boilers or between the boilers and deck, which usually becomes very hot. As to the economy in fuel between these two systems and that of the well-known closed stokehole and natural-draft systems, I do not think that correct data have yet been obtained; but according to the reports of several engineers with whom I have conversed on the subject, there seems to be a saving of from 8 to 12 per cent. over the natural draft and closed stokehole in favor of the hot-air systems.

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A Good Train Record.

The most important railway records are not those of single runs. The following style is far more to the point. The Chesapeake & Ohio Railway between Washington and Cincinnati maintains four vestibuled limited trains. For the four months March-June of this year each train covered 599 miles 122 times, making a total of 292,312 miles, or about eleven and three-quarter times the circumference of the earth, and the trains were on time 463 times out of a possible 488. For the number of trains, the period covered, the distance run, and the mountainous nature of the country traversed, the figures speak in highest praise of the management and maintenance of the road.

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Varieties of Iron Mining.

The methods and conditions of mining iron ores vary greatly in cost and difficulty, ranging from stripping and mining with the steam shovel to working with rock drills many hundreds of feet below the earth's surface. Some mines are worked as open cuts, but most are underground, and all the different methods of long wall mining, caving, milling, overhand and underhand stoping, as well as the various systems of timbering and filling, are said to be in active use in the iron mines of the Lake Superior region alone. The character of the ore varies almost as much as its surroundings, from soft material, easily shoveled from its native bed, to rock so hard as to severely test the best rock drills. On the Chicago drainage canal, drills working in the limestone there would drill from one hundred to one hundred and twenty feet in ten hours, while drills of the same size and driven at the same pressure could not cut more than five or six feet in the same time in the hard Minnesota ores, and eighteen to twenty feet in those of the Marquette mines.

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Rapid Shipbuilding on the Lakes.

If the exigency should ever arise requiring the rapid turning-out of a fleet, we need have no fear of our capabilities in that direction. While we are deploring the low ebb of the shipbuilder's occupation in the United States, we have still before us an object lesson of what we can do if we have a chance. Never before in the history of American shipbuilding has such work been seen as has been done in the construction of the Bessemer Steamship Company's fleet of lake freight ships. The company was formed in the first week of December of last year and contracts were at once made with lake shipyards, then fairly busy with other work, for the building of twelve great ships, each larger than any others on the lakes, except one afloat and two under contract for another company. As we write, eight of these ships are in commission, and the remaining four will be finished in October. Four other ships have been bought, and in ten months from the decision to build, the company will have a carrying capacity of 65,000 tons on present draft and 95,000 tons on the deeper draft soon to be available. This fleet will be able to handle about 2,000,000 tons of ore in one season of navigation. The cost of the fleet will be about $3,400,000.

The vessels of the Bessemer fleet have been appropriately named for men famous for their connection with the mining, engineering and metallurgical world. The flagship of the fleet is the "Sir Henry Bessemer," while among the others are such names as "Nasmyth," "Ericsson," "Corliss," "Krupp," "Fulton," "Watts," "Siemens," "Ball," "Fairbairn" and "Holley." Amid all the development of the lake marine and steel interests in the last few years, it has strangely remained for this new company to honor the memories of the greatest men these industries have had.

The vessels are built on a guarantee to carry, on 14 feet draft, 4,000 gross tons, and those that have been tried have slightly exceeded these figures.

The evolution of lake shipping from the craft of a dozen years ago, when 1,500 tons was the maximum, has been wonderful. As deeper and deeper channels have been provided by the Government, the enlarged vessels have been ready in advance of the completion of each improvement, and the Government has been continuously pushed by the shipowners. Still larger ships are already being planned, up to 500 feet in length, and a carrying capacity approaching 9,000 tons.

Within ten years, freight rates were tenfold greater than now, the Gogebic shippers at one time paying nearly $6 per ton to get their ores to Cleveland. Now the big ships can carry at a cost of 50 cents a ton, and a steady rate of 80 cents would be a good enough thing for any owner.

These steamers, since they have been put in service, show excellent speed for freight boats. The "Bessemer" and the "Siemens," built by the Globe Company, Cleveland, make 15 miles light and 13½ miles loaded. The cylinders of the "Bessemer" are 25, 41 and 66 inches, by 42-inch stroke.

The United States Circuit Court of Appeals has decided in the case of the Empire Transportation Co., appellants, versus the Philadelphia & Reading Coal & Iron Co., that a delay in discharging the cargo from a vessel caused by a strike of employés of the charterer without grievance or warning, and a successful effort on their part to prevent the vessel from being unloaded, makes the charterer not liable for damages.

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Our readers may have noticed that in connection with the recent grounding of the battleship "Texas," Captain Glass blames a machinist for this grounding; yet it is the claim of the Line that little or no responsibility devolves upon those who are below deck. It will occur to most people in this case to inquire what the "Texas" was doing in such shallow water.

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Help Wanted.

Situation and Help Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. The Cash and Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

TO SUBSCRIBERS

whose names appear on our subscription list, this paper will give two free insertions under this heading to those in want of positions. The advertisement to occupy a space of not more than five lines. Additional space or insertions must be paid for in advance at regular rates.

Mechanical draftsman desires position; good references. Box 78, AMERICAN MACHINIST.

Wanted—A responsible position in repair shop of cotton mill. Box 296, AMERICAN MACHINIST.

A successful man wants a position as superintendent or general foreman. Box 64, AM. MACH.

Expert draftsman, experienced machine designer, open for engagement. Box 73, AM. MACH.

Foundry foreman with considerable experience wants pos.; American; best refs. Box 76, AM. MACH.

Wanted—By the Nellis Belt Fastener Co., 284 Pearl street, New York, hustling salesmen on their patent fastener and pulley covering.

Draftsman wishes position; technical graduate; experienced in modern wood-working machinery and Corliss engine work. Box 77, AM. MACHINIST.

Wanted—Salesman for our celebrated lubricating & wool oils; side line or exclusively. Secure territory at once. Howard Oil & Grease Co., Cleveland, O.

Young man, tool maker, wants position; has equipped and had charge of cycle factory, making 200 cycles per week; references. Box 79, AM. MACH.

Mech'l dftsman, desires sit.; exp. in mach. tools, gen'l and spec. mach'y, shop tools, jigs and fixtures; good designer; 8 yrs. exp. refs. Box 72, AM. MACH.

Wanted—A position as foreman or draftsman by a practical and theoretical draftsman and machinist; experienced in reducing cost of production; best references. Box 299, AMERICAN MACHINIST.

Wanted—Position by an experienced man on forging and metal forming wires and tool for carriage bicycles, etc.; several years' experience as foreman; thorough on shop order and piece work system. Box 66, AMERICAN MACHINIST

Superintendent would like to correspond with parties requiring the services of a man of thoroughly practical and executive ability; extensive experience in the designing and manufacture of bicycles, special tools, etc. Box 75, AM. MACH.

Tool maker, machinist, steady, experienced in tool room, shop machinery and repairs, tools for screw machines, turret lathes and milling machines, used to micr meter, measurements and drawings, wants position. Box 74, AM. MACHINIST.

Wanted—A thorough reliable mechanic, able to take charge of milling, drilling and screw making department of large cycle works in the North of England; latest American machines used; only men having the very best experience need apply. Address Elswick Cycles Co., Ltd., Elswick Court, Northumberland St., Newcastle-on-Tyne, England.

Thoroughly experienced engineer and machinist, under 40, capable buyer and salesman, perfectly steady and reliable, competent to take entire management of works, engines and boilers, gen'l and special mach'y or manfg., can make accurate estimates, well versed in modern practice, now filling position of manager, would like to correspond with view to making change. Box 298, AM. MACHINIST.

Wanted—For large cycle works in the North of England, a first-class head tool maker; one who thoroughly understands the construction of the latest and most approved tools for the production of parts by automatic and other machinery; best American makes; only a steady, reliable and energetic man need apply. Address Elswick Cycles Co., Ltd., Elswick Court, Northumberland Street, Newcastle-on-Tyne, England.

Business—A gentleman with means and undoubted reference would like to form a connection with parties desiring to be represented in the Pacific States. The party is more particularly conversant with machinery, but has spent many years in mercantile pursuits. State in answer line of manufacture you desire to introduce. Address P. O. Box 2055, San Francisco, Cal., and if satisfactory, correspondence or personal visit will follow.

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Miscellaneous Wants.

Advertisements will be inserted under this head at 30 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

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Calipers & Gauges. F. A. Welles, Milwaukee, Wis.

Best and cheapest Bolt Header, made by Baush & Harris Machine Tool Co.

Light and fine mach'y to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

For Sale—Second-hand drill presses, engine lathes & planers. Dietz, Schumacher & Boye, Cincinnati, O.

Rose's "Machine Shop Practice" wanted; 2 vols., edition of 1894 or 1895. Address John Jos. McVey, 39 North 13th street, Philadelphia, Pa.

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Wanted—An Idea. Who can think of some simple thing to patent? Protect your ideas; they may bring you wealth. Write John Wedderburn & Co., Patent Attorneys, Washington, D. C., for their $1,800 prize offered to inventors.

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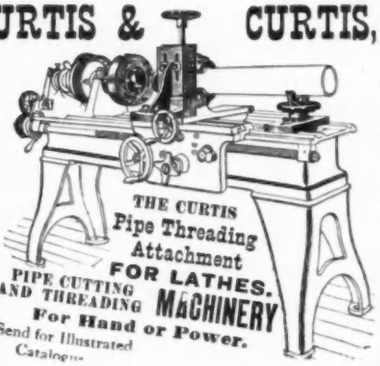

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A new feature in connection with industrial disputes has been introduced by the Miners' Union at Leadville, Colorado, the members of which, being out of work on account of such difficulty, offer to lease the mines, drain them and operate them, and pay the owners at 25 per cent. royalty, pay the Union scale for all labor, and give a guarantee bond of $100,000.

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Commercial Review.

NEW YORK, SATURDAY EVENING, SEPT. 19TH.

Liberty Street.

By Liberty street, we mean the machinery trade—and in the present instance the iron and wood working tool branches of that trade—for what Wall street is to the finance of the country, that Liberty street is to the machinery interests of New York and vicinity.

Wall street has already enjoyed several weeks of convalescence, and may have Liberty street to thank for a part of it; because the inflow of gold, which has greatly increased the sub-treasury's factor of safety is due to a surplusage of exports over imports. But Liberty street itself moves more slowly. People don't speculate in machinery, they invest in it; and while speculators trade in probabilities investors wait for certainties.

So it is not surprising that the old story of delayed recovery from dulness can still be told of iron working machinery, notwithstanding there are some signs that the disease has made a turn for the better. Several of the leading houses in this city report a little improvement in demand or inquiry. One of the more important of these (one of the few not situated on Liberty street) remarks: "There is only a flea bite of business here and a flea bite there, but more of them it is true than in August." No one would assert that September business begins to be what it would under normal circumstances; but a few admit that they do not find it quite as bad as during August. Yet taking the entire weight of opinion in the local market and in connection with this, the letters we publish this week from out-of-town concerns we are afraid that this is not true of the average. But whatever may be the case at present, expectations are bright.

It is prophesied by the sanguine that when November comes with its resumption of business, he who has the tools in stock will get the orders. Not everyone is so thoroughly imbued with this idea as to lay in extra heavy stocks on account of it, but politics are rampant to the extent that a vacant building on Liberty street, where not long since engines and boilers were sold, is now a temple dedicated to what "the machinery and metal industries" are supposed to believe about gold and silver. And this, it must be acknowledges, is about the nearest approach to a

feature that Liberty street this month can boast of.

We print the following letter from Mr. G. A. Gray, president of the well-known company of that name, in Cincinnati: "The demand for metal planing machines from this country has been very light since the first of the year, and for the last two months orders have stopped almost altogether. We are running, however, almost full force full time, on foreign orders, which have come to us in the 'nick' of time to bridge us over, we hope, until the present muddle is definitely settled and the country has declared itself for honest money."

The Fitchburg (Mass) Machine Works, manufacturers of metal working machinery, state as follows: "In common with nearly every manufacturer we find business quiet. Particularly in the line of regular work we find a limited demand for tools, but a large part of our work for the past two months has been on special machinery. We have been running full time and are looking for a better condition of trade in the near future."

The Hurlbut-Rogers Machine Co., South Sudbury, Mass., makers of cutting off and centering machines, write: "We have had unusually good business during the past year, but find that we are having fewer orders for the last month, probably owing to the uncertainty of the election."

Whatever may be the present condition of the iron-working machinery business, from a domestic point of view, it would seem to be better than that of the market for wood-working machinery. A representative of the latter line of goods informs us that he knows of as many as five of the companies manufacturing it whose works have ceased running; and another party, who hails from Boston, pronounces a certain wood-working factory in New Jersey, where 75 or 80 men out of a total force of 400 are now employed, to be the busiest he has seen. Summer months, however, are usually quiet in point of demand, and so the present may be just the time when comparative inactivity in the shops is to be expected.

It appears that the project of the National Asociation of Manufacturers, referred to in our last number, to establish a sample warehouse for American goods in Venezuela, is to be duplicated in several instances by the Exporters' Association of America, which is about to open a series of sample, or salesrooms in advantageous localities, such as the Levant, Cape Colony, Rio Janeiro, Buenos Ayres and the City of Mexico. The association has taken the pains to obtain, through agents, some information regarding the field open in Greece for American goods. The cotton spinning and weaving mills, they say, are rapidly increasing in that country, several new mills being in course of construction and fitting out. This, although

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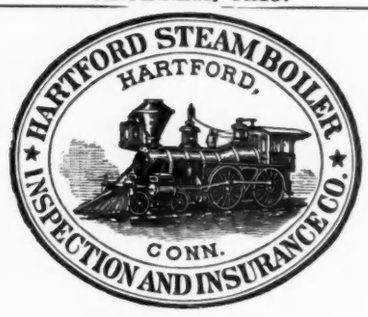

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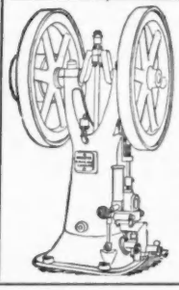
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WEBSTER 2 1-2 ACTUAL HORSEPOWER
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For $150, less 10 per cent. discount for cash. Built on the interchangeable plan. Built of the best material. Made in lots of 100, therefore, we can make the price. Boxed for shipment, weight 800 pounds. Made for Gas or Gasoline.
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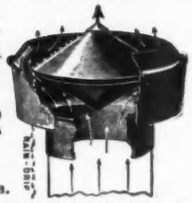

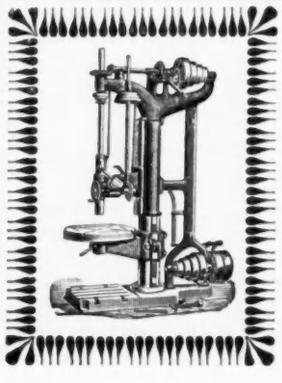

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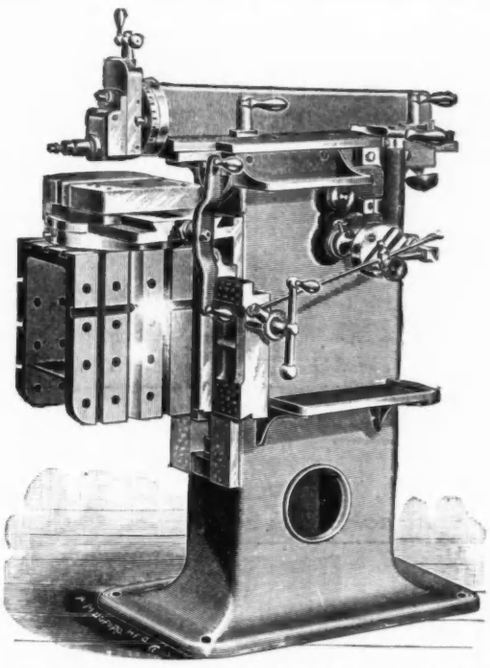

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Useful : Attachments.
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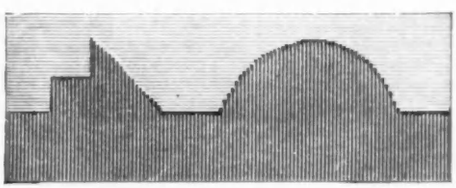
The stroke can be adjusted for curves with machine in motion. The stroke can be adjusted for angles with machine in motion. The stroke can be adjusted for irregular work with machine in motion. It has adjustable table for planing taper work, table can be removed for fastening work to apron. Has a strong graduated swivel vise. Quick work, rapid changes, modern ideas.



This cut shows how stroke can be adjusted with machine in motion by micrometer, adjustment fine and delicate. Send for circular.

The Hendey Machine Co.

Torrington, Conn.

European Agents, Chas. Churchill & Co., London and Birmingham. Schuchardt & Schutte, Berlin. Eugen Soller, Basel, Switzerland.

stated with a view of stimulating the introduction of American cotton, may show also an avenue open to American textile machinery. About 400 bicycles are imported into Greece annually and some of those of a certain American make which have found their way there are considered better than the English, German or French; so that the field is thought to be a good one for American wheels. The demand is principally for those of medium price. Another line of products mentioned is that of files, of which the most popular are now manufactured by three English firms and one German, the latter selling ten per cent. cheaper than the former. A steamship line to run directly from this country to Eastern Mediterranean ports is advocated. Apropos to the textile machinery outlook it may be said, that many of the New England textile mills are resuming and extending operations.

The Greenfield Engine Works, East Newark, N. J., have recently shipped two metal presses to Germany. They report their business exceedingly good at present, but do not state whether this is owing chiefly to a domestic or a foreign demand.

Export shipments of machinery, from New York, as per Custom House reports made during the week ending September 19th, amounted to $183,592. Nearly two-thirds of this, in value, was bound for Europe.

Iron and Other Metals.

That the iron market is improved in tone over last month is distinctly recognized. Both Southern and Northern irons feel it. The merely speculative buying which characterized the early stages of the upward movement is not the whole of the story, for, according to the New York report in Rogers, Brown & Co.'s weekly circular, the demand from actual consumers has at least quadrupled, as compared with a month ago. Iron took the lead in last year's short-lived improvement, and it is doing fair credit to itself in connection with the present upward trend of business, which, in spite of the depressing influences of the approaching election, has evidently commenced. Still, there is, as yet, nothing like a boom in the iron market, and, except by contrast with what it has been, it must be pronounced quiet.

The cold-rolled steel shafting manufacturers' "combine" met on Monday, but made no change in prices.

The metals have shown little animation during the week.

Quotations.

NEW YORK, Monday, September 21st.

Iron—American pig, tidewater delivery :	
No. 1 foundry, Northern	$11 75 @ $13 00
No. 2 foundry, Northern	11 25 @ 12 00
No. 2 plain, Northern	10 50 @ 11 00
Gray Forge	10 50 @ 10 75
No. 1 foundry, Southern	11 25 @ 11 50
No. 2 foundry, Southern	10 75 @ 11 00
No. 3 foundry, Southern	10 25 @ 10 50
No. 1 soft, Southern	10 75 @ 11 00
No. 2 soft, Southern	10 75 @ 11 00
Foundry forge, or No. 4 Southern	10 00 @ 10 25

Bar Iron—Base—Mill price, in Carloads, on dock; common, 1.10 @ 1.20c.; refined, 1.20 @ 1.35c. Store prices: common, 1.40 @ 1.50c.; refined, 1.50 @ 1.70c.

Tool Steel—Ordinary sizes, standard quality, 5½ @ 7c.; extra grades, 11 @ 12c.; special grades, 16c. and upward.

Machinery Steel—From store, 1.65 @ 1.75c. Special brands upward

Cold Rolled Steel Shafting—Base size in carloads, about 2½c.; 2¾c. for smaller quantities from store.

Copper—Carload lots, Lake Superior ingot, 10⅝ @ 10⅞c.; electrolytic, 10½ @ 10⅝c.; casting copper, 10¼ @ 10½c.

Pig Tin—For 5 and 10 ton lots, 13.12½c., f.o.b. spot; lower for a few days' later delivery.

Pig Lead—In carload lots, quoted to-day at 2.80 @ 2.85c., f. o. b.; but the rioting at Leadville, Col., which constitutes a chief item of news in this afternoon's papers, may cause an advance.

Spelter—In carload lots. New York delivery, 3.60 @ 3.75c. for various Western brands.

Antimony—Cookson's, 7 @ 7.25c.; Hallett's, 6.40 @ 6.50c.; Japanese, 6.40 @ 6.50c.

Lard Oil—Prime city, present make, commercial quality, in carload lots, 38 @ 40c.

▲ ▲ ▲

Manufactures.

The Greenville Tube Co., Greenville, Pa., will install new machinery.

Georgia Slate Co., Rockwart, Ga., will erect a plant, and install new machinery.

The power house of the street railway company at Owosso, Mich., is to be enlarged.

The Halifax Shoe Co. Halifax, Pa., will enlarge their plant, and place new machinery.

The Norristown Wire Co., Norristown, Pa., will increase their plant, and place new machinery.

At Reading, Pa., the Chantrell Tool Co. are doubling the capacity of their works.

The Oliver Wire Co., of Pittsburgh, Pa., are adding new machinery of an improved type.

W. H. Hamilton & Co., Pittsburgh, Pa., will erect a large glass plant, and install new machinery.

The Hall Safe and Lock Co.'s works and offices will be removed from Cincinnati to Hamilton, O.

The Swift Creek Cotton Mfg. Co., Petersburg, Va., will erect a plant, and install new machinery.

Claude E. Swayer, Aiken, S. C., will erect an ice plant, and equip it with the latest improved machinery.

The Conococheague Brick and Earthenware Co., Williamsport, Md., will erect a plant, and install new machinery.

The Dunsmore Electric Light Co., Dunsmore, Pa., will erect a plant and equip it with the latest improved machinery.

The Municipal Council at Nanaimo, B. C., will spend $3,000 in new equipment and appliance for the Fire Department.

Wm. F. McSparran, Fairfield, Lancaster County, Pa., will erect a cannery, and install all new and improved machinery.

The Council of Parrsboro, N. S., have secured the services of an engineer to prepare plans for a system of water works.

The Seneca Glass Co., of Fostoria, O., will be removed to Morgantown, W. Va., where the plant will be considerably enlarged.

The Connellsville Suburban Street Railway Co., Connellsville, Pa., will erect a plant, and install new machinery. Capital $25,000.

A new basket factory is to be built at Grand Haven, Mich. C. Bos, of Grand Haven, and Jas. Edwards, of Agnew, Mich., are interested.

A new concern has been incorporated at Charleroi, Pa., to manufacture electric supplies. It is known as the People's Electric and Mfg. Co.

Lansing Boiler and Engine Works, Lansing, Mich., $100,000 will be expended in thoroughly equipping a plant to manufacture boilers and engines.

H. T. Bush & Co., Detroit, Mich., filed articles of incorporation, capital $200,000, to manufacture machinery planers, drilling machines, engines, etc.

There is a new grain elevator projected at Grand Haven, Mich. The Crosby Transportation Co., of Grand Haven and Muskegon, Mich., is interested.

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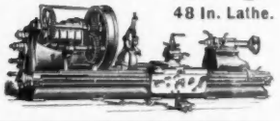

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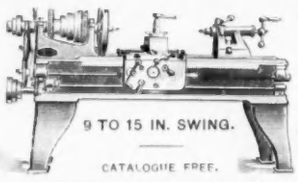

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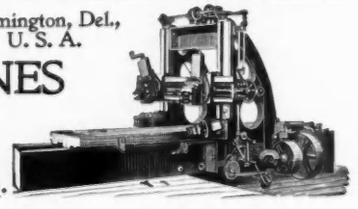

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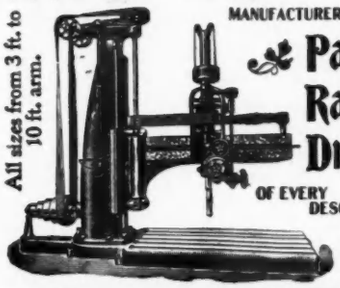

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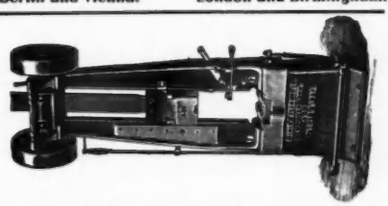

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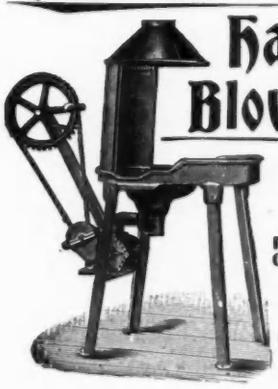

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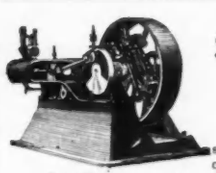

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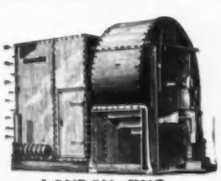

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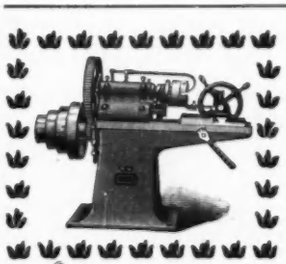

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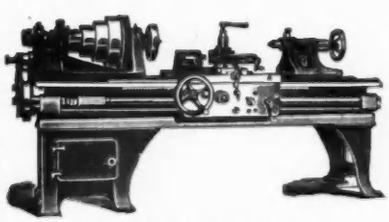

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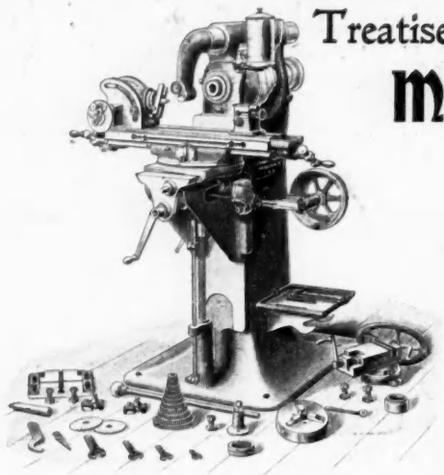

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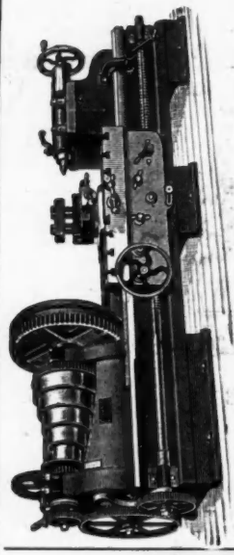

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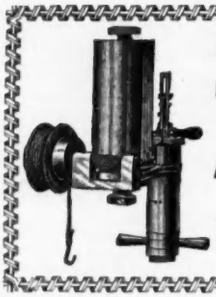

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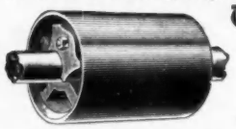

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